Burrendong Wind Farm

Environmental Impact Statement

Ark Energy

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DOCUMENT TRACKING

Project Name	Burrendong Wind Farm – Environmental Impact Statement
Project Number	22COF - 4000
Project Manager	Daniel Magdi
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Approved by	Rachel Murray
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ACKNOWLEDGEMENTS

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Declaration

Project Details	
Project Name	Burrendong Wind Farm
Application Number	SSD - 8950984
Address of the Land in Respect of which the Development Application is Made	The suburb of Yarrabin, approximately 30 km west of Mudgee, NSW in Mid-Western Local Government Area.

Applicant Details	
Applicant Name	Burrendong Wind Farm Pty Ltd
Applicant Address	Level 2, 275 George Street Sydney NSW, 2000

Details of Person by Whom this EIS was Prepared	
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Professional Qualifications	Principal Environmental Consultant

Registered Environmental Assessment Practitioner	
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Registration Number	R80015
Organisation Registered With	Environment Institute of Australia and New Zealand (EIANZ)

Declaration
The undersigned declares that this EIS:

- has been prepared in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulation 2021*;
- contains all available information relevant to the environmental assessment of the development, activity or infrastructure to which the EIS relates;
- does not contain information that is false or misleading;
- addresses the Planning Secretary’s environmental assessment requirements (SEARs) for the project;
- identifies and addresses the relevant statutory requirements for the project, including any relevant matters for consideration in environmental planning instruments;
- has been prepared having regard to the Department’s State Significant Development Guidelines - Preparing an Environmental Impact Statement;
- contains a simple and easy to understand summary of the project as a whole, having regard to the economic, environmental and social impacts of the project and the principles of ecologically sustainable development;

- contains a consolidated description of the project in a single chapter of the EIS;
- contains an accurate summary of the findings of any community engagement; and
- contains an accurate summary of the detailed technical assessment of the impacts of the project as a whole.

Signature	
Date	29 September 2023

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Abbreviations

Abbreviation	Description
ACHA	Aboriginal Cultural Heritage Assessment
AEMO	Australian Energy Market Operator
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
APZ	Asset Protection Zone
ARENA	Australian Renewable Energy Agency
BAM	Biodiversity Assessment Method
BBAMP	Bird and Bat Adaptive Management Plan
BC Act	*Biodiversity Conservation Act 2016*
BDAR	Biodiversity Development Assessment Report
BoM	Bureau of Meteorology
BOS	Biodiversity Offset Scheme
CEEC	Critically Endangered Ecological Community
CES	Community Engagement Strategy
CO_{2-e}	Carbon Dioxide Equivalent
CoRTN	Calculation of Road Traffic Noise
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAWE	Department of Agriculture, Water Environment (Commonwealth)
DCP	Development Control Plan
DEM	Digital Elevation Model
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DPE	Department of Planning and Environment
DPIE	Department of Planning, Industry and Environment (NSW, now reverted to DPE)
DoEE	Department of the Energy and Environment
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EMF	Electric and magnetic fields
EP&A Act	*Environmental Planning & Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000*
EPBC Act	*Environment Protection & Biodiversity Conservation Act 1999*
EPC	Electrical Plant Compound
ESD	Ecologically Sustainable Development

Abbreviation	Description
FBI	Fire Behaviour Index
FM Act	*Fisheries Management Act 1994*
GHG	Greenhouse Gas
GW	Gigawatts
GWh	Gigawatt hours
IBRA	Interim Biogeographic Regionalisation for Australia
IEC	International Electrotechnical Commission
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
KFH	Key Fish Habitat
LBB	Large Bent-winged Bat
LCA	Life Cycle Assessment
LCOE	Levelized Cost of Energy
LEP	Local Environmental Plan
LGA	Local Government Area
LRET	Large-scale Renewable Energy Target
LSPS	Local Strategic Planning Statement
LVIA	Landscape and Visual Impact Assessment
MNES	Matters of National Environmental Significance
NEM	National Energy Market
NDC	Nationally Determined Contribution
NM	Nautical Miles
NRAR	Natural Resources Access Regulator
NSW	New South Wales
NT Act	*Native Title Act 1993*
OEH	Office of Environment and Heritage (now DPIE)
O&M	Operation and Maintenance
OSOM	Over Size, Over Mass vehicle
PBP	Planning for Bushfire Protection
PCT	Plant Community Type
PVIA	Preliminary Visual Impact Assessment
PS SEPP	*State Environmental Planning Policy (Planning Systems) 2021*
RE Act	*Renewable Energy Act 2000*
RET	Renewable Energy Target
REZ	Renewable Energy Zone

Abbreviation	Description
RFS	NSW Rural Fire Service
rLoS	Radar Line of Sight
SDG	Sustainable Development Goals
SEARs	Secretary’s Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SHR	State Heritage Register
SIA	Social Impact Assessment
SoDAR	Sound Detection and Ranging
SoHI	Statement of Heritage Impact
TEC	Threatened Ecological Community
Transport and Infrastructure SEPP	*State Environmental Planning Policy (Transport and Infrastructure) 2021*
WTG	Wind Turbine Generator
WWEA	World Wind Energy Association
ZVI	Zone of Visual Influence

Key Terms

Term	Definition
Ancillary Infrastructure	All infrastructure necessary for the construction and operation of the wind farm apart from WTGs, including but not limited to: substations, switching stations, permanent offices and site compounds, underground and overhead electricity transmission lines, meteorological masts, communication cables (includes control cables and earthing), water storage tanks, hardstands and internal roads.
Development Corridor	The area generally bound by a buffer of 100 m radius around the Development Footprint as shown in Figure 1-2.
Development Footprint	The extent of ground disturbance including earthworks associated with permanent infrastructure and temporary facilities in the Project Site.
External Road Upgrades	Upgrade of roads external to the Project Site and associated vegetation clearing and/or pruning, required to transport Project-related components and materials to and from the Project Site.
Internal Roads	The roads established within the Project Site for the purposes of constructing, operating, maintaining, and decommissioning the Project (including waterway crossings).
Meteorological Masts	Temporary and Permanent masts up to hub height of the WTGs and of a guyed, narrow lattice or tubular steel design and concrete footings of approximately 1 m^2 for each of the mast and guy wires. The final number and location of the masts will be determined post-Development Consent, post-WTG selection and detailed design.
Micro-siting	The process of locating WTGs, ancillary infrastructure, and temporary infrastructure during detailed design without further approval providing: • the ground disturbance remains within the Development Corridor • no WTG is moved more than 100 metres from the relevant GPS coordinates shown in Appendix B.
Operation	The carrying out of the approved purpose of the development upon completion of construction but does not include commissioning trials of equipment or use of temporary facilities.
Permanent Infrastructure	Infrastructure that will remain on the Project site during for the operational phase of the Project, including WTGs and ancillary infrastructure.
Pre-construction Minor Works	Includes the following activities: • Surveys. • Building/road dilapidation surveys. • Investigative drilling, excavation, or salvage. • Minor clearing or translocation of native vegetation. • Establishing temporary site office and compounds. • Installation of environmental impact mitigation measures, fencing, enabling works, meteorological masts. • Flora and fauna investigations and pre-clearing surveys, inspections, specific habitat feature removal, relocation. • Establishing Project Site access points, minor access roads and minor adjustments to services/utilities, signage etc. including associated vegetation removal and heritage artefact salvage.
Project	The Burrendong Wind Farm described in Section 3 of this EIS.

Term	Definition
Project Site	The land required for the Project as shown in Appendix B and shown in Figure 1-2 and includes Crown land, Crown waterways, Crown roads and Council roads located within the boundary of the Project Site shown in Figure 1-2.
Temporary Facilities	Temporary facilities used for the construction, repowering and/or decommissioning of the Project, including but not limited to temporary site offices, amenities, and compounds, rock crushing facilities, concrete or asphalt batching plants, stockpiles and materials storage compounds, temporary laydown areas, minor 'work front' construction access roads and temporary meteorological masts.
WTG	Wind Turbine Generator: turbines used for the generation of electricity by wind, including the tower, blades, and associated components.

CHAPTER 1

Introduction

1.1. Context

The threat of climate change is significant and wide ranging and can largely be attributed to decades of unabated use of hydrocarbon based and non-renewable energy sources, known as fossil fuels. Widespread reliance on fossil fuels to support the many transports, food, material, electrical and other needs of society has resulted in significant greenhouse gases emissions, primarily in the form of carbon dioxide (CO_2), into the atmosphere, leading to increased global temperatures. Consequently, international, national, and state actors have established, signed, or otherwise committed to goals for rapid decarbonisation and reduction of greenhouse emissions. Activities include the implementation of energy policies, agreements, conventions, and frameworks which focus heavily on transformation from fossil fuel reliance to adoption of renewable energy sources such as wind and solar power.

In the domestic context, Australia is a signatory to several international initiatives related to climate change and emissions reduction, including the United Nations Framework Convention on Climate Change (UNFCCC) (referred to as the Paris Agreement), ratified by Australia in 2016. The primary goal of Australia's commitment to the Paris Agreement is to reduce CO_2 emissions by 43% below 2005 levels by 2030 (DCCEEW 2022). In support of this commitment, the Australian Government's Renewable Energy Target (RET) was established to provide a framework for renewable energy investment and establishes a target for installation of 33,000 Gigawatt hours (GWh) of renewable energy each year between 2021-2030.

New South Wales (NSW) plays a growing role in the energy transition, as state-based policies help drive the development of renewable energy projects across the state. The NSW Government has committed to halving emissions from 2005 levels by 2030 and achieving net zero carbon emissions by 2050 under the Net Zero Plan Stage 1 and 2 (DPE 2023). This aligns with the NSW Electricity Strategy which recognises the importance of encouraging the deployment of renewable energy to help replace the states' ageing coal generators (DPIE 2019a). Coupled with the Electricity Infrastructure Roadmap (DPIE 2021b) and establishment of Renewable Energy Zones (REZs) around NSW, the NSW Government continues to facilitate development of renewable energy projects. The demand for clean and affordable renewable energy is continuing to grow as the opportunity to avoid catastrophic climate change is narrowing, and both governments and consumers become increasingly aware of, and willing to act on, the risks of fossil fuel reliance.

The proposed Burrendong Wind Farm (the Project), located in the Central-West Orana REZ (Figure 1-1), will contribute to rapid adoption and development of renewable energy which help to tackle the challenges of climate change and global warming. More specifically, the Project will aid in achieving the following objectives:

- Supply clean, reliable energy to the National Energy Market (NEM)
- Reduce CO_2 emissions by over 1.3 million tonnes per year (DCCEW 2010)
- Provide a range of community benefits including, but not limited to, community sponsorship of local events, local employment during both the construction and operation phases, injection of money into the local and regional economy and the establishment of a community benefit fund administered under a Voluntary Planning Agreement (VPA). The Mid-Western Regional Council and Dubbo Regional Council are to receive $3,000 per WTG per year, totalling $210,000 per year and $10 million over the 30-year life of the Project.

- Improve the security of electricity supply through diversification in generation sources and distribution of wind generators within the Central-West Orana REZ.

Additionally, in late 2022, the *Central West and Orana Regional Plan 2041* was released to provide a 20-year vision for priorities and objectives across the region in which the Project is located. The 2041 Plan builds upon objectives previously set out in strategic plans and ensures the character and identity of the region is celebrated and protected. With the consideration of climate change risk and its impacts on the region, the 2041 Plan seeks to facilitate renewable energy development to adapt to and mitigate climate change, among other strategies. The 2041 Plan reinforces the significant potential of the region to support renewable energy projects, given its elevated tablelands that are capable of efficient wind energy production.

1.2. Project Overview

The Project consists of the installation, operation, maintenance, and decommissioning of up to seventy (70) Wind Turbine Generators (WTGs), electrical infrastructure, ancillary infrastructure, public road upgrades and access tracks and temporary facilities. The Project is designed to accommodate WTGs up to 250 m in height, with a nameplate capacity (or maximum effect) of approximately 6-7 MW or greater. On these terms, and subject to Development Consent and market changes, the Project is estimated to have an installed generating capacity of approximately 400-500 MW. The Project would connect to the existing TransGrid 330 kV transmission line to the west of the Project Site, on the western side of Lake Burrendong. The Project Site layout is shown in Figure 1-2.

The Project will produce clean energy to power the equivalent of approximately 247,000 average NSW households each year[1]. The electricity generated by the Project would also provide approximately 900,000 tonnes of carbon dioxide equivalent ($CO_{2\text{-}e}$) savings relative to the incumbent NSW electricity generation mix on an annual basis[2].

The Project will directly sustain approximately 250 Full Time Equivalent (FTE) positions and indirectly sustain a further 400 FTE positions over the construction period of the Project. A further 12 direct and 35 indirect FTE jobs will be created during the 30-year operational period. The operational workforce will consist of a local workforce or staff relocating to the region to fill the roles. Additionally, the increase in local stimulus because of the Project will create indirect jobs throughout the construction period.

The conception and development of the Project has undergone a comprehensive process that incorporates community and stakeholder feedback. This has allowed the Project to maximise positive social, economic, and environmental outcomes while minimising adverse impacts and unintended deleterious consequences.

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[1] Household estimate based on ACIL Allen Energy Benchmarks Report 2017, pg. 37 (updated 5 June 2018).

[2] Based on DECCW's NSW Wind Farms and Greenhouse Gas Savings Report Table 1: Wind Farm Output and Greenhouse Gas Savings.

1.3. Project Location

The Project is located within the traditional lands of the Wiradjuri Aboriginal Nation in the Dubbo Regional Council and Mid-Western Regional Council Local Government Areas (LGAs) in the New South Wales (NSW) state electorate of Dubbo. The Project Site is approximately 35 km west of Mudgee located in the state suburbs of Yarragal, Yarrabin, Hargraves, Mumbil, and Dripstone (Figure 1-1). The Project Site layout is shown in Figure 1-2.

1.4. Purpose of this Document

This Environmental Impact Statement (EIS) has been prepared for Ark Energy on behalf of Burrendong Wind Farm Pty Ltd to support a State Significant Development Application (SSDA) to build and operate a wind farm.

The Project has a capital investment value above $30 million. Under the *State Environmental Planning Policy (Planning Systems) 2021* (Planning Systems SEPP), formerly the *State Environmental Planning Policy (State and Regional Development)* 2011 (SRD SEPP), electricity generating works (including wind power) that have a capital investment value of more than $30 million are classified as State Significant Development (SSD) and require approval under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) through the preparation of an EIS. As such, this EIS has been prepared under Part 4 of the EP&A Act, in accordance with the Secretary's Environmental Assessment Requirements (SEARs), dated 30 September 2022 (Appendix A), and the requirements of Schedule 2 of the *Environmental Planning and Assessment Regulation 2021* (EP&A Regulation).

Under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), Matters of National Environmental Significance (MNES) are protected. The EPBC Act requires approval for significant impacts on MNES to be approved by the Commonwealth Minister for the Environment. The potential for impacts to MNES are considered throughout the EIS, and the likely significance of potential impacts are presented in Section 6.5. The Project was referred to the Commonwealth Minister for the Environment and determined a Controlled Action on 11 July 2022 (2022/09268). The Project will be assessed in a manner specified in Schedule 1 to the Bilateral Agreement made under Section 45 of the EPBC Act (Appendix B).

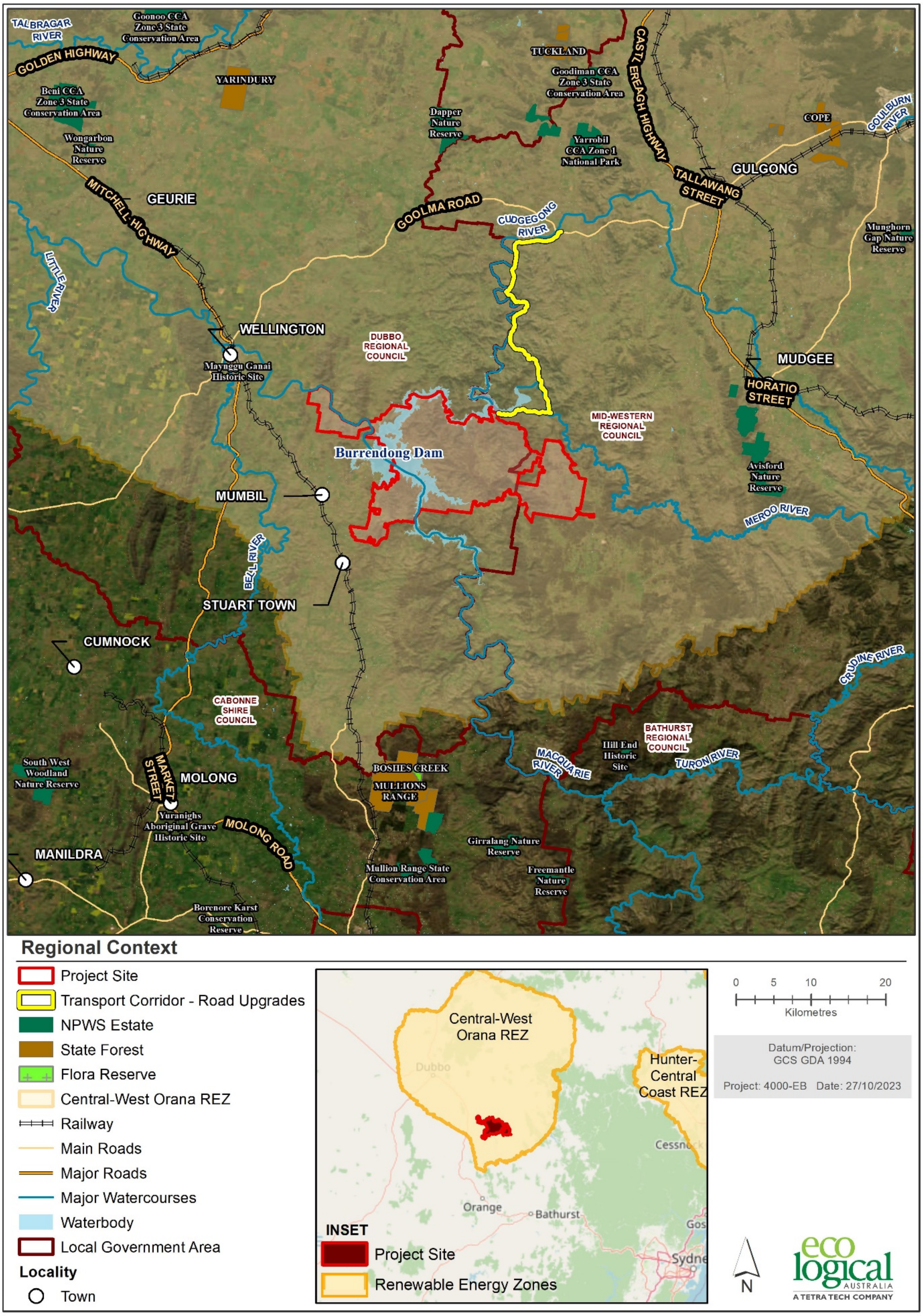


Figure 1-1: Regional Context of the Project Site

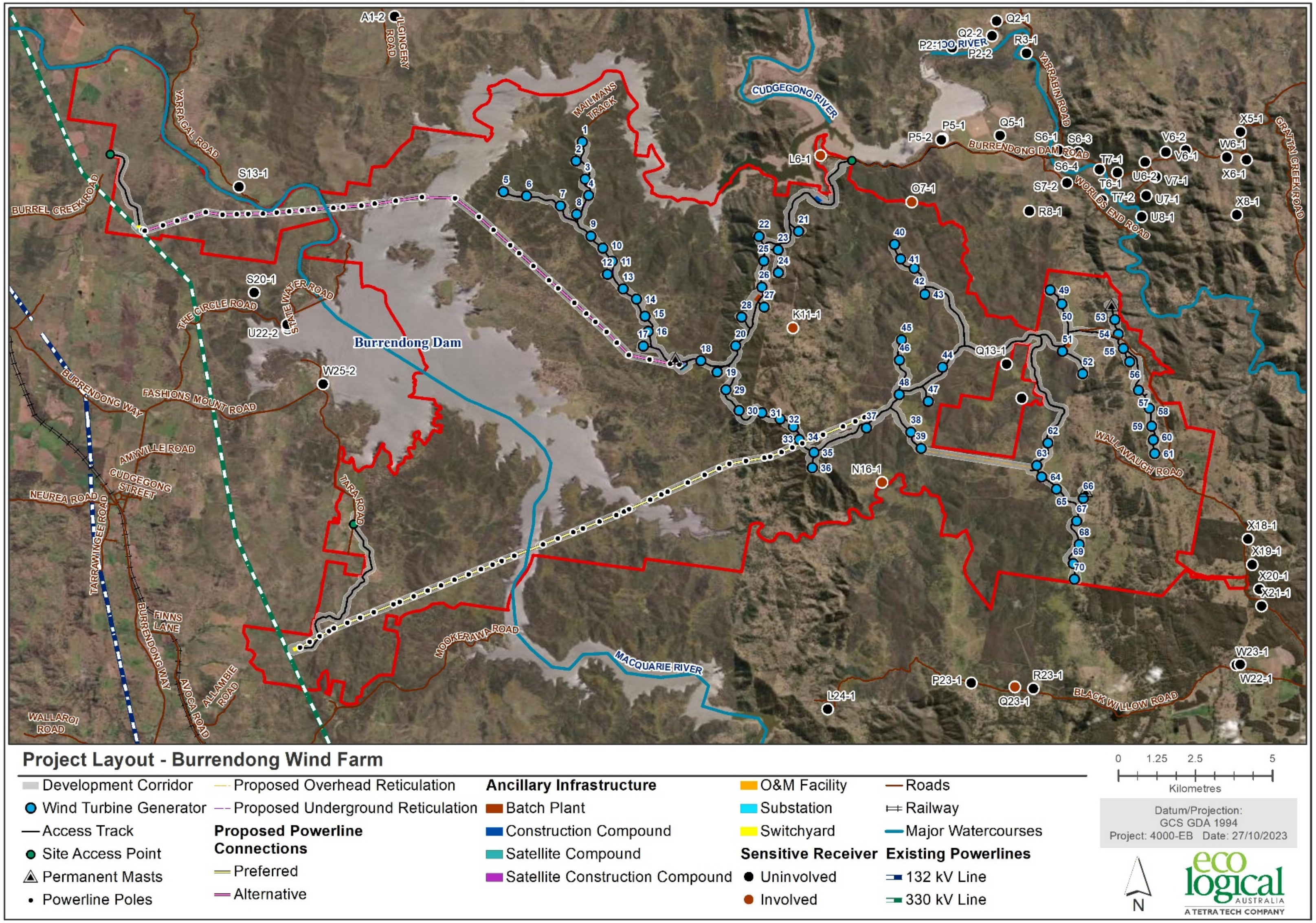


Figure 1-2: Preliminary Project Layout

1.5. The Proponent

The Proponent of the Project is Burrendong Wind Farm Pty Ltd, a wholly owned subsidiary of Ark Energy Corporation Pty Ltd (Ark Energy), an Australian renewable energy company and subsidiary of Korea Zinc Co. Ltd. In 2022, Ark Energy acquired Epuron, one of the most experienced wind energy development companies in NSW, as well as a significant developer of solar projects across Australia. Ark Energy is also at the forefront of development of Australia's green hydrogen industry.

Table 1-1 summarises the Proponent's details.

Table 1-1: Proponent Details

Proponent Details	
Proponent	Burrendong Wind Farm Pty Ltd
Address	Level 2, 275 George Street, Sydney 2000
ABN	49 657 154 633

Following the acquisition of Epuron in 2022, Ark Energy also took over ownership of Epuron's large portfolio of wind and solar energy projects across Queensland, New South Wales, and Tasmania. The portfolio of renewable energy assets under Ark Energy includes the following projects in development, under construction of currently operating:

- White Rock Wind Farm – 175 MW wind farm in Glen Innes, NSW (operating, owned by Goldwind)
- Doughboy Wind Farm – 50-60 WTGs 40 km east of Armidale, NSW (in development, owned by Ark Energy)
- Liverpool Range Wind Farm – 267 WTGs, approx. 1,000 MW in the Upper Hunter Valley, NSW (pre-construction, owned by Tilt Renewables)
- Bowmans Creek Wind Farm – 56 WTGs in Muswellbrook, NSW (in development, owned by Ark Energy)
- Coppabella Wind Farm – 284 MW 20 km west of Yass, NSW (pre-construction, owned by Goldwind)
- Rye Park Wind Farm – 327 MW, north of Yass, NSW (under construction, owned by Tilt Renewables)
- Gullen Range Wind Farm – 165.5 MW, Crookwell, NSW (operating, owned by Goldwind)
- Cullerin Range Wind Farm – 30 MW, Cullerin, NSW (operating, owned by EDL).

Further details can be found at the website www.arkenergy.com.au.

1.6. Structure of the EIS

The EIS has been prepared in accordance with the EP&A Act, EP&A Regulation, the SEARs (outlined in Appendix A) and all other relevant legislation to support the application for approval. The purpose of this EIS is to:

- Provide the consent authority with sufficient information, regarding the benefits and potential environmental impacts of the Project, to make an informed decision regarding approval.

- Provide the community with sufficient information about the Project.
- Provide measures to reduce any potential environmental impacts associated with the Project.

As part of this assessment, numerous relevant and/or required technical studies were undertaken to inform the EIS. A summary of the technical consultants and their associated assessment is provided in Table 1-2. The structure of the EIS is outlined Table 1-3.

Table 1-2: Technical consultants involved in the Project

Technical Assessment	Technical Consultant
Landscape and Visual Impact Assessment	Moir Landscape Architecture Pty Ltd (MLA)
Noise and Vibration Impact Assessment	Marshall Day Acoustics Pty Ltd (MDA)
Biodiversity Development Assessment Report	Eco Logical Australia Pty Ltd (ELA)
External Route Study	iCubed consulting Pty Ltd (iCubed)
Transport Route Study	Rex J Andrews (RJA)
Traffic and Transport Impact Assessment	Stantec
Aviation Impact Assessment	Aviation Projects Pty Ltd (Aviation Projects)
Telecommunications Impact Assessment	Middleton Group Pty Ltd (Middleton Group)
Bushfire Risk Assessment	ELA
Aboriginal Cultural Heritage Assessment	ELA
Historic Heritage Assessment	ELA
Soils, Land Use and Agricultural Land Impact Assessment	Tucker Environmental
Surface Water, Groundwater, and Flood Impact Assessment	ELA
Riparian Land and Aquatic Ecology Impact Assessment	ELA
Resource Requirements and Waste Impact Assessment	ELA
Social Impact Assessment	Ethos Urban Pty Ltd (Ethos)
Economic Impact Assessment	Ethos

Table 1-3: EIS Structure

Section	Section Title	Content
1	Introduction	Project overview.
2	Strategic Context	Strategic needs for the Project, Project objectives, alternatives considered and justification.
3	Project Description	Description of the Project design, construction activities, operation, and ancillary facilities.
4	Statutory Framework	Review of applicable local, state and Commonwealth legislation and policies.
5	Community Engagement	Overview of the stakeholder and community consultation undertaken to date, and a summary of future consultation during the approval process.
6	Environmental Assessments and Mitigation	Environmental risk analysis for all potential environmental impacts that have been considered within this EIS; assessment of potential environmental impacts including visual, noise and vibration, biodiversity, traffic, hazards and risks, heritage, water and soils, waste and socio-economic and cumulative impacts

Section	Section Title	Content
		and recommended environmental mitigation measures and residual environmental risk assessment.
7	Project Justification and Conclusion	Evaluation and justification of the construction, operation and decommissioning of the Project through the consideration of triple-bottom-line considerations (environment, community, and economics) and its potential benefits to the local, regional and NSW community; summary of the overall potential environmental impacts associated with the construction, operation and decommissioning of the Project and a statement confirming the Project is compliant with the requirements for SSD under the EP&A Act and other relevant state and Commonwealth legislation.
8	References	References used throughout this assessment.

CHAPTER 2

Strategic Context

2.1. Strategic Need for the Project

The Australian energy sector has long been dominated by the use of coal and gas to generate electricity. The burning of these carbon intensive fossil fuels is directly linked to atmospheric pollution and carbon emissions associated with climate change. The scientific consensus on climate change and energy systems is clear on the need to rapidly scale down energy produced using fossil fuels. Renewable energy generation continues to mature and demonstrate numerous social, economic, and environmental benefits associated with transitioning to a low carbon energy system. Increased adoption of renewable energy as an energy source in Australia will continue to support transition away from carbon intensive energy production that has dominated the energy landscape.

The Project will play an important role in addressing the need for affordable, renewable electricity to assist with the phasing out of fossil fuel generators, as well as provide the following strategic benefits:

- mitigate the impacts associated with global warming and climate change by displacing 900,000 tonnes of CO2-e from the current NSW energy generation supply, which is heavily reliant on coal powered generation.
- contribute to achieving Australia's commitment to the Paris Agreement of reducing emissions by at least 43% below 2005 levels by 2030.
- contribute to three (3) UN Sustainable Development Goals (SDGs):
    - Goal 7 – Affordable and Clean Energy
    - Goal 11 – Sustainable Cities and Communities
    - Goal 13 – Climate Action
- contribute to achieving Australia's annual Renewable Energy Target to install 33,000 GWh of renewable energy.
- implement the aims of NSW's Net Zero Plan Stage 1: 2020-2030 and contribute to NSW's aspirational target of reducing greenhouse gas (GHGs) emissions by 50% by 2030, compared to 2005 levels and net zero emissions by 2050.
- implement the aims of NSW's Electricity Strategy by providing over $30 million in capital investment in NSW's electricity system, particularly in regional NSW.
- provide a source of energy generation that is well positioned to meet future global and national demand for electricity, which possesses one of the lowest production costs, uses no water during electricity production and is mature technology acceptable to energy utilities in comparison to other renewable energy sources.
- provide a source of energy generation that is competitive in cost through technological advancements and Levelised Cost of Energy (LCOE) (IRENA 2021).
- provide energy generation technology that has a low carbon intensity across the Project life compared to other forms of energy.
- provide mutually agreed opportunities for landowners, neighbours, and the wider community to share in the benefits of the Project such as community benefit contributions, community co-investment opportunities and the establishment of a community benefit fund.
- provide approximately 250 FTE jobs consistently during the construction phase with a peak of 375, generating significant local investment (including wage stimulus) that may be spent within nearby local and regional communities such as Yarrabin and Hargraves.

2.1.1. Greenhouse Gas Emissions Reduction

The generation of electricity both globally and nationally are considerable drivers of greenhouse gas emissions (GHG). As shown in Figure 2-1 and Figure 2-2, electricity generation is increasingly driving the overall GHG emissions both globally and in Australia. The increase in renewable energy developments like the Project will have a material impact on reducing GHG emissions and creating an energy network that is low carbon. The NSW Government has developed the NSW Wind Farm Greenhouse Gas Savings Tool as part of the Renewable Energy Precincts initiative (DECCW 2010). The tool allows community and industry alike to easily calculate the projected greenhouse gas savings from new wind farms across NSW, including within the Central-West Orana REZ.

The NSW Wind Farm Greenhouse Gas Savings Tool estimates savings by multiplying the output from a wind farm with the emissions intensity of the electricity supplied in the NEM. The emissions intensity of electricity supplied in the NEM varies according to the location and size of a new wind farm, so site specific emission intensities must be used for differently sized developments within each Renewable Precinct. Over time the emission intensity of electricity supplied in the NEM is predicted to reduce with increasing penetration of gas fired plants relative to coal fired plants (as accounted for in the Greenhouse Gas Savings Tool).

The Project will have an installed capacity of approximately 400-500 MW, dependent on the final WTG model and layout selection. Table 1 of the NSW Wind Farms and Greenhouse Gas Savings Tool (DECCW 2010) was used to estimate the greenhouse gas savings from the Project with an installed capacity of approximately 400-500 MW, which is approximately 900,000 tonnes of $CO_{2\text{-}e}$[1]. Using this the tool, the Project is calculated to power approximately 247,000 homes each year[2], assisting in the transition towards national and international environmental commitments. The power generation potential demonstrates the progress being made towards national and international environmental commitments. The environmental benefits of developing renewable energy sources and transitioning to a low carbon future will manifest in benefits across local communities and international borders.

2.1.2. Response to Climate Change Globally

The increasingly deleterious impacts of anthropogenic climate change occurring across the globe demonstrate the importance of international commitments and agreements designed to limit further human induced impacts. There is an international consensus on the need for reductions in carbon usage and GHG emissions across the globe, reinforced by various commitments and initiatives including pathways implemented by the United Nations Framework Convention on Climate Change (UNFCCC) (referred to as the Paris Agreement and ratified by Australia in 2016). The Paris Agreement brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort.

The Paris Agreement sets out a global framework to address climate change and limit global warming to well below 2° C, and ideally 1.5° C compared to pre-industrial levels. Creating a legally binding international treaty on climate change, the agreement was adopted by 196 parties, and sets a goal to limit warming through climate positive actions of countries around the world. The Australian Government ratified the Paris Agreement in November 2016, committing to an unconditional Nationally Determined Contribution (NDC) to reduce emissions by 26-28% below 2005 levels by 2030. Following the Federal election in May of 2022, the newly elected Labour Government quickly implemented updated climate policy reforms. This included an update to Australia's NDCs by increasing the emissions reduction target to a minimum 43% by 2030 and a commitment to net zero emissions by 2050.

Modelling from international bodies such as the International Energy Agency (IEA) and IPCC illustrate the scale of change required to achieve the global goals of the Paris Agreement and highlight the need for increased renewable energy projects. The IPCC Working Group III Report (IPCC 2022a) found that 'global GHG emissions in 2030 associated with the implementation of NDCs announced prior to COP26 would make it likely that warming will exceed 1.5° C during the 21st century'. Using the model outlined in the Sixth Assessment Report from the IPCC, the Climate Council concluded that Australia would need to reduce its emissions by 75% below 2005 levels by 2030 to achieve net zero emissions by 2035 (Climate Council 2021; Climate Action Tracker 2021). This is currently at odds with the Federal Government's updated commitment of reducing emissions by 43%. Low emissions technologies such as wind power have been demonstrated to provide clean, scalable energy solutions and will be needed to contribute to a rapidly increasing share of global electricity production to achieve net zero emissions. Indeed, the Federal Government in 2022 began to implement legislation to address the effects of climate change, including the *Climate Change Bill 2022* which legislated Australia's commitment to a 43% emissions reduction target by 2030 (DCCEEW 2022b). Though current pathways are not projected to meet the level of change needed, the adoption of the Paris Agreement has helped facilitate the development of much needed renewable energy projects as both private industry and public opinion seeks out renewable energy alternatives to energy generation.

The United Nations 2030 Agenda for Sustainable Development includes a set of 17 interdependent global Sustainable Development Goals (SDGs) to help build a more sustainable and resilient future for all. The SDGs are broken down into 169 individual targets to stimulate and measure action towards improving economic, social, and environmental sustainability. All countries of the world have agreed to work towards achieving the SDGs by 2030. Of specific relevance to the Project are *SDG 7 (Affordable and clean energy), 11 (Sustainable cities and communities), and 13 (Climate Action)*. The Project will respond positively to Goal 7 Affordable and Clean Energy specifically and will contribute towards Target 7.2: 'By 2030, increase substantially the share of renewable energy in the global energy mix'. The UN explains:

> *"Transitioning the global economy towards clean and sustainable sources of energy is one of our greatest challenges in the coming decades. Sustainable energy is an opportunity – it transforms lives, economies, and the planet"*

The primary function of the Project is to generate renewable energy and increase the amount of renewable energy in Australia's energy mix, while concurrently improving affordability in the energy market. The Project will also contribute towards Goal 11 Sustainable Cities and Communities (Target 11.6) by helping to reduce Australia's reliance on power from fossil fuels which will improve air quality and have positive impacts on health and wellbeing.

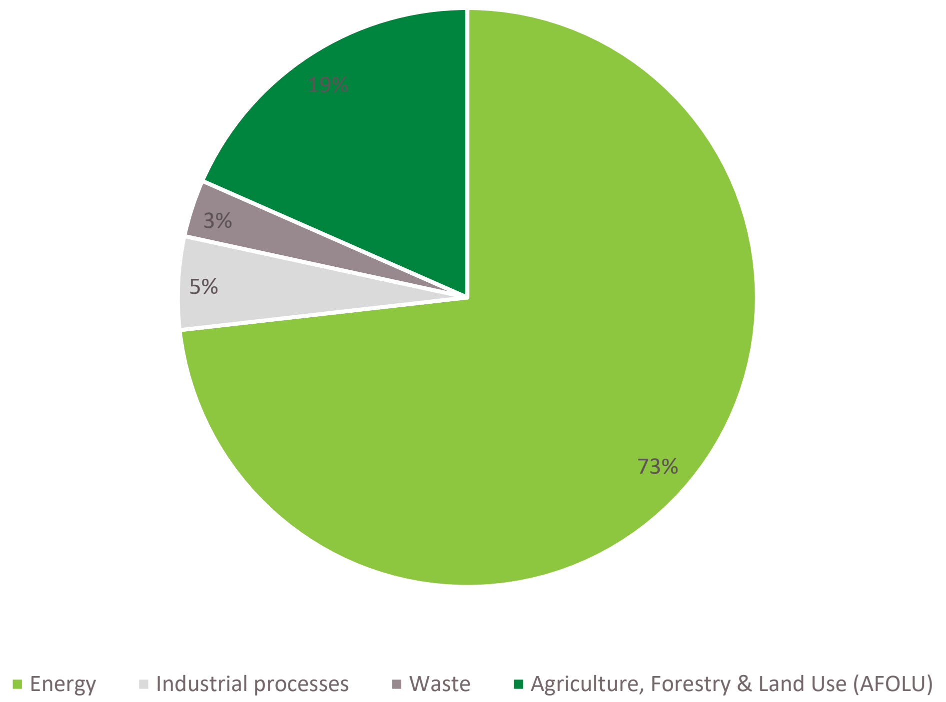


Figure 2-1: share of global greenhouse emissions by sector (%), globally (Our World In Data 2020)

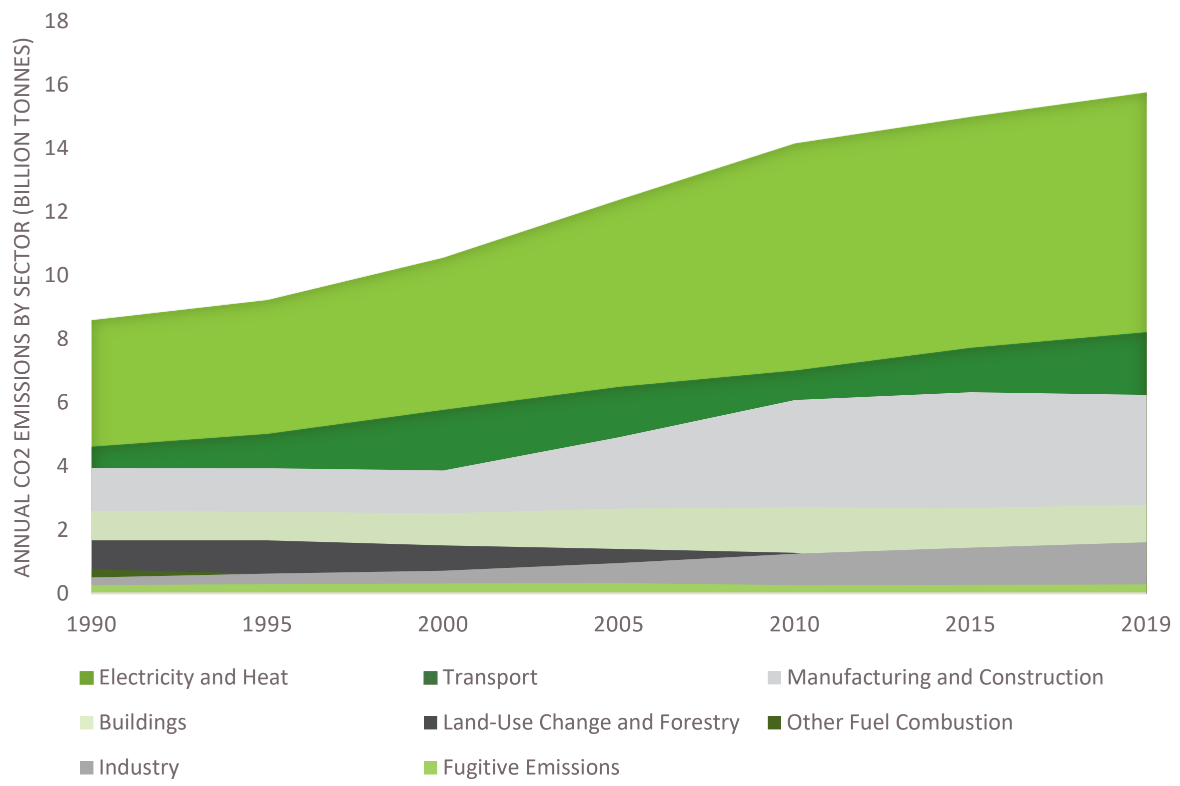


Figure 2-2: Australian $CO_{2\text{-}e}$ emissions by sector in 2021 (DCCEEW 2022)

The global average temperature has risen approximately 0.8° C higher than the 1961-1990 baseline and a further 0.4° C since 1850. Overall, this amounts to an average temperature rise of 1.22° C (Figure 2-3; OWID 2019). The IPCC Special Report on Global Warming of 1.5° C (IPCC 2018) has estimated that global surface temperatures are likely to further increase to 1.5° C above pre-industrial levels between 2030 and 2052 if the current rate of global warming is sustained.

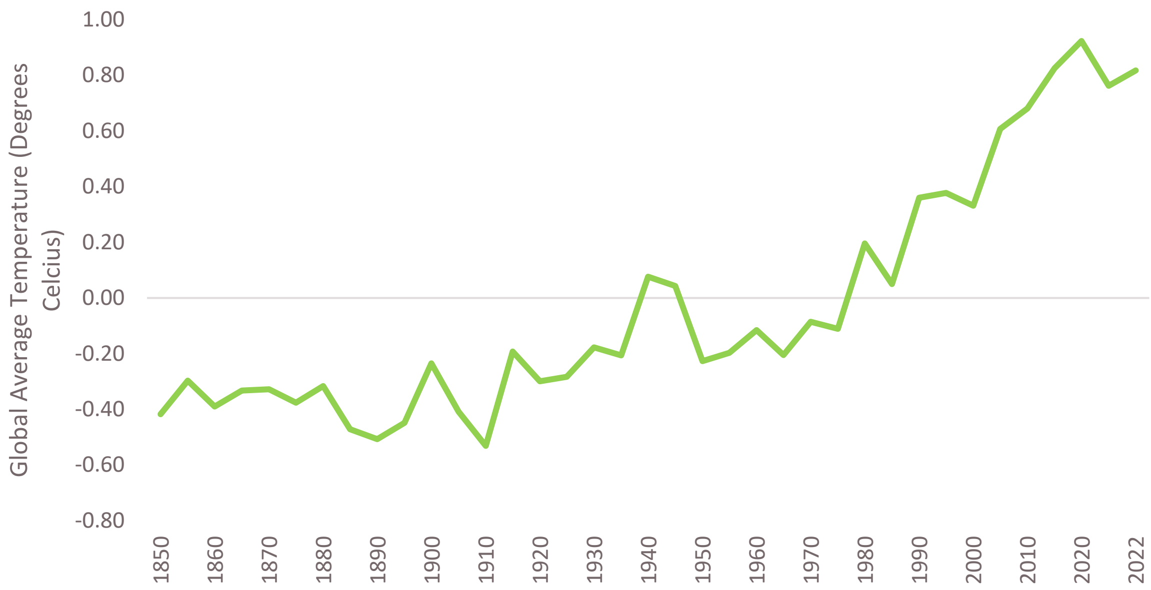


Figure 2-3: Global average temperature, relative to the 1961-1990 average temperature (OWID, 2019)

Continued and unrestricted emission of greenhouse gases is projected to cause further warming and long-lasting changes across all components of the climate system, increasing the likelihood of severe, pervasive, and irreversible impacts for people and ecosystems. Limiting climate change will require substantial and sustained reductions in GHG emissions which, together with adaptation, can limit climate change risks (IPCC 2018, IPCC 2022a). The IPCC (2022a) notes that there are multiple mitigation pathways that are likely to limit warming to below 2° C relative to pre-industrial levels, with the goal of limiting warming as close to 1.5° C as possible. All the mitigation measures include a rapid and expansive increase in renewable energy sources to deliver low emissions energy, while simultaneously electrifying the grid. Since the energy sector is the highest emitting, reductions in this sector should be a high priority globally. The IPCC's 'Below 1.5° C mitigation pathways' includes a strong increase in primary energy production from renewable sources by 2050 (52% - 67% supply share), improvements in energy efficiency, as well as a reduction in energy generation from coal (1% - 7% decrease) (IPCC 2018). The latest Working Group III Report (IPCC 2022a) notes that a contributing factor to the increase in primary energy production from renewables is due to their sustained decrease in unit costs, with the unit cost of solar and wind energy decreasing by 85% and 55% respectively between 2010 and 2019.

2.1.3. Response to Climate Change in Australia

In June 2015, the Australian Parliament passed the *Renewable Energy (Electricity) Amendment Bill 2015* and established the Large-scale Renewable Energy Target (LRET) (CER 2022). This target was designed to incentivise the development of large-scale renewable energy generation in Australia through a market mechanism involving the sale of 'large-scale generation certificates'. This mechanism is a market-based mechanism as part of the broader Australian Government approach to emissions reduction and transitioning the grid towards one where renewable energy proliferates.

The Commonwealth *Renewable Energy Act 2000* (RE Act) was passed by Federal Parliament in August 2009 and aimed to acquire 45,000 GWh of Australia's electricity from renewable sources by 2020. However, this was then reduced to 37,000 GWh in 2015. To meet the RET, it was estimated that approximately 6,400 MW of new large-scale renewable energy capacity was required to be built and connected to the NEM by 2020, with wind power expected to form most of this new generation capacity. This target was met and exceeded in 2019. The RET will continue to provide a framework for ongoing renewable energy investment, instating a target of installing 33,000 GWh of renewable energy each year between 2021 – 2030.

The Climate Solutions Fund was established in February 2019 by the DotEE, which is designed to help achieve Australia's emissions reduction target of 5% below 2000 levels by 2020 and 26-28% below 2005 emissions by 2030. The fund acts as the mechanism to help Australia achieve its NDC under the Paris Agreement. The fund operates alongside existing programmes working to reduce Australia's emissions growth such as the Renewable Energy Target. While the Project is not eligible for funds associated with the Climate Solutions Fund, it is consistent with the policy objectives of the Clean Energy Finance Corporation (CEFC) which seeks to "accelerate investment in Australia's transition to net zero emissions by 2050" (CEFC 2022). The fund provides $10 billion to invest in clean energy on behalf of the Australian Government to accelerate the transition to zero emissions and help achieve Australia's emissions reduction targets. As one of the most active investors in renewable energy in Australia, the CEFC provides an opportunity for the Project to leverage federal policy objectives of advancing the uptake of renewable energy. The Project will therefore contribute to both the increasing local and global need for renewable projects, as well as aid in mitigating the issues of global warming and climate change.

In April 2021, former Prime Minister Scott Morrison participated in the Virtual Leaders' Summit on Climate, hosted by U.S. President Joe Biden, providing an update on Australia's progress towards achieving commitments to reduce greenhouse gas emissions. In advance of the summit during a speech to the Business Council of Australia, the then Prime Minister indicated a preference for achieving a net zero economy by 2050, noting that 'the key to meeting our climate change ambitions is commercialisation of low emissions technology' (Glenday 2021). While these statements were not mandated policies, they indicated that stakeholders across the political spectrum recognise the need for Australia to achieve net zero emissions by 2050.

While Australia is making strides in its attempts to address climate change, these attempts are not always equally beneficial or well implemented. For example, the Kyoto Protocol was entered into force in 2005 and formed a commitment by industrialised and developing nations to limit and reduce greenhouse gases in one of the early, global scale actions on climate change. The commitment negotiated by Australia was an increase of 8% in its emissions during the first phase of the Protocol and included the 'Australia Clause' which allowed for reduced land clearing levels as emissions reduction. Following high levels of land clearing during the baseline year of 1990, land clearing levels dropped significantly allowing additional emissions reductions to be 'counted' towards Australia. This emissions 'reduction' strategy created ambiguity around the effective level of emissions reduction Australia had achieved.

The federal response to climate change in Australia is complex and often lopsided in its attempts to address increasing climatic challenges. This is evident in the release of the Climate Change Authority's First Annual Progress Report which outlined the expected emissions reduction by 2030 and the need to cut carbon emissions by 17 million tonnes per year to achieve its 43% reduction target (Climate Council 2022). Australia's role in combating climate change will be marked with significant challenges if it is to meet its promised target of net zero by 2050 and will rely on help from stakeholders across a range of groups and communities. The need to reduce emissions by 17 million tonnes presents an opportunity for the Proponent to actively contribute to Australia's fight against climate change by avoiding over 1.3 million tonnes of C02-e each year while providing clean energy for thousands.

2.1.4. Response to Climate Change in New South Wales

Since 1990, emissions from all sectors in NSW have decreased, excluding energy which has seen an increase (NSW Government 2022). Most emissions in NSW are derived from electricity generation, representing 37% of total emissions. The Net Zero Plan Stage 1: 2020-2030 (DPE 2023) is the foundation for NSW's action on climate change and goal to reach net zero emissions by 2050. It outlines the NSW Government's plan to grow the economy, create jobs and reduce emissions over the next decade. The plan aims to enhance the prosperity and quality of life of the people of NSW, while helping the state to deliver a 35% cut in emissions by 2030 compared to 2005 levels (Figure 2-4) (EPA 2023). It will support a range of initiatives targeting electricity and energy efficiency, electric vehicles, hydrogen, primary industries, coal innovation, organic waste, and carbon financing.

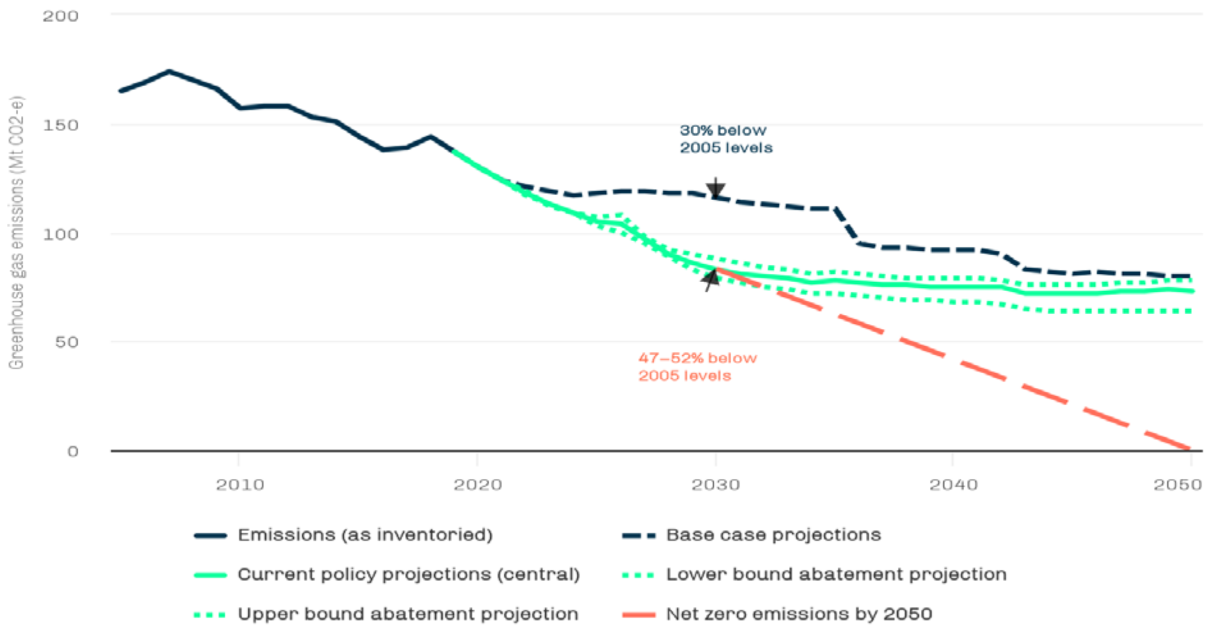


Figure 2-4: NSW total annual emissions to 2019 and anticipated emissions to 2030 under the Net Zero Plan (EPA 2023)

The implementation of the Net Zero Plan, together with the NSW Electricity Strategy, will result in more than $11.6 billion of new investment for NSW, including $7 billion in regional NSW. This will support the creation of almost 2,400 new jobs, including 1,700 jobs located in the regions.

Furthermore, the strategy sets out a plan to deliver five REZs in the state's Central-West Orana (pilot), New England, South-West, Hunter Central Coast, and Illawarra regions. The Central-West Orana REZ is expected to be the first to begin construction in 2024 (ANZIP 2022). These REZs will play a vital role in delivering affordable, reliable energy generation to help replace the state's existing power stations as they come to their scheduled end of operational life. This will be achieved by using economies of scale to stimulate energy generation projects within defined areas and connecting to integrated transmission links. The broad effect of these REZs will help to reduce wholesale electricity costs.

Of the five (5) proposed REZs, the Central-West Orana has been formally declared by the Minister for Energy and Environment under section 19(1) of the *Electricity Infrastructure Investment Act 2020*. The Project is poised to capitalise on the REZ and contribute to the generation of centralised renewable energy in NSW. The REZs will play a vital role in delivering affordable energy to help replace the state's existing power stations as they retire over the coming decades.

2.2. Project Location Context

The Project is located within both the Dubbo Regional Council and Mid-Western Regional Council areas near the townships of Hargraves and Yarrabin. The township of Hargraves is a small community approximately 35 km west of Mudgee, located within the Central Tablelands of NSW. Lying entirely within the Murray-Darling Basin, the Central-West Orana region is characterised by wide valleys and floodplains and distinct seasonal variations in temperature (OEH 2014).

The dominant land use surrounding the Project Site are agricultural, with sections of the Project Site located on land zoned E3 – Environmental Management. Lake Burrendong is also adjacent to the Project Site on the western side.

The Hargraves community has a small public school (Hargraves Public School) and General Store along with rural residences and structures associated with agricultural land uses (ABS 2021). According to the 2021 ABS Census, there were 300 people in Hargraves (ABS 2021). Other small rural communities in proximity to the Project Site include:

- Yarragal
- Mookerawa
- Worlds End
- Lake Burrendong
- Triamble
- Mumbil and Stuart Town.

2.2.1. Key Landscape Features

In addition to agricultural land uses, the region is characterised by scenic landscapes, large valleys and floodplains, natural environments and wine producing areas. The Project Site borders Lake Burrendong to the West and is surrounded by agricultural land to the north, east and south.

The Project Site is within the Macquarie River catchment area. The Macquarie River runs through the Project Site with several small tributaries running through the landscape comprising of 1st, 2nd, 3rd and 4th order streams and ephemeral creeks. Burrendong Dam is located within the Project Site. Figure 1-1 provides a visual overview of the Project Site and key landscape features in the region, including watercourses and reserves.

2.2.2. Key Transport and Infrastructure

The Project Site is in proximity to the major centres of Mudgee (35 km by road to the east) and Wellington (30 km by road to the northwest) and is benefitted by major road and rail routes that connect the LGAs to the wider region. Major roads and rail lines include:

- Castlereagh Highway
- Mitchell Highway
- Burrendong Way
- Gwabegar railway line; and
- NSW TrainLink.

The region is also serviced by regional airports including:

- Mudgee Airport (30 km east)
- Orange Regional Airport (60 km south)
- Bathurst Airport (75 km southeast)
- Dubbo Airport (> 100 km northwest).

The Mudgee Airport is the only regional airport located within 30 nautical miles (nm) of the Project Site. Additionally, while several uncontrolled aerodromes are found within the region, none are in proximity to the Project Site.

The WTG equipment may be supplied through domestic manufacturing or likely imported and arrive at port. The Port of Newcastle has been assessed as the likely port of entry for shipped Project components.

2.2.3. Other Renewable Energy Projects in the Locality

The Project Site is not located adjacent to any other existing wind or solar renewable energy projects. However, there are 14 other renewable energy projects at various stages of development within both the same REZ and LGAs (i.e., Central-West Orana REZ and Dubbo Regional and Mid-Western Regional Councils) (Table 2-1).

Table 2-1: Renewable Energy Projects in the same REZ and LGAs

Energy Type	Project	Distance from Project Site	Status
Wind	Uungula Wind Farm	8.8 km north	Approved
	Bodangora Wind Farm	22.0 km northwest	Operational
	Spicers Creek Wind Farm	43.9 km northwest	In Planning
	Barney Reef Wind Farm	55.2 km northeast	In Planning
Solar	Sandy Creek Solar Farm		In Planning
	Dubbo Solar Farm		Operational
	Suntop Solar Farm		Operational
	Wellington Road Solar Farm		Approved
	Maryvale Solar Farm		Approved
	Wellington North Solar Farm		Under Construction

Energy Type	Project	Distance from Project Site	Status
	Wellington Solar Farm		Operational
	Stubbo Solar Farm		Approved
	Beryl Solar Farm		Operational
	Burrundulla Solar Farm		In Planning
	Geurie Solar Farm		Approved
	Forest Glen Solar Farm		In Planning
	Sheraton Road Solar Farm		Approved
	Tallawang Solar Farm		In Planning
	Bellambi Heights Solar Farm		In Planning
	Birriwa Solar Farm		In Planning
	Ulan Solar Farm		In Planning
Hydro	Burrendong Hydro Power Station	6 km northwest	Operational
Transmission	Central-West Transmission Link		In Planning

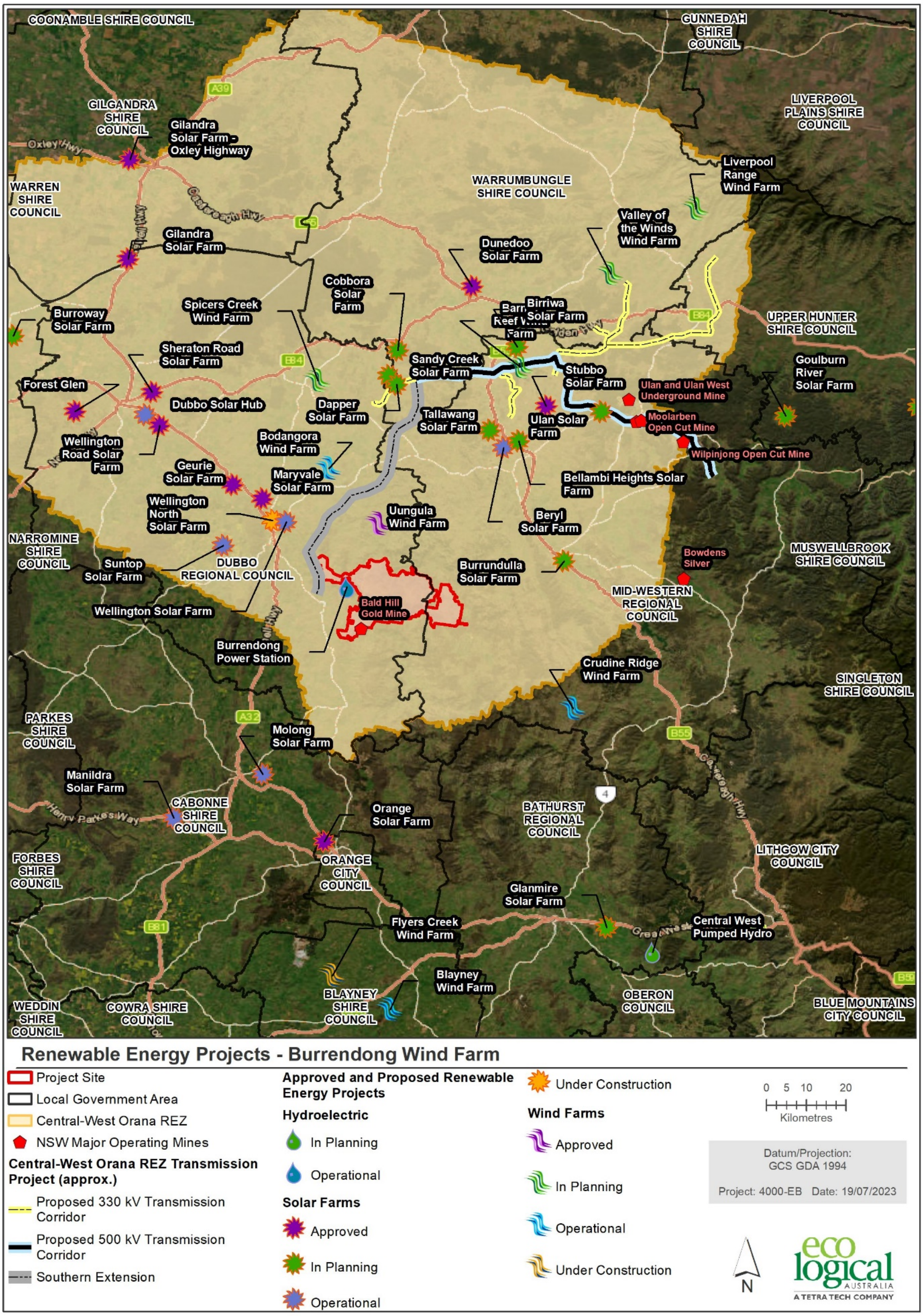


Figure 2-5: Renewable energy projects within the region

2.2.4. National Energy Market Capacity and NSW Electricity Transmission Upgrades

The NEM encompasses five states and a transmission network of approximately 40,000 km (AEMO 2021) and is largely supplied to by coal fired generators. With a total electricity generating capacity of 65,252 MW (AEMO 2021), Australia's grid connection network is physically long and thin and not designed to store and transport mass electricity generated from large-scale renewable energy projects. To facilitate the transition towards renewable energy as the dominant supplier of energy in the NEM, significant updates are required to the transmission network. Challenges to overcome include facilitation of connection of renewable energy projects into a system that features thin and long transmission lines limiting capacity to transport electricity, a lack of transmission lines and grid bottlenecks due to connection infrastructure.

AEMO's 2022 *Integrated System Plan* provides a comprehensive roadmap for the National Electricity Market. The development of REZs is required to maximise renewable energy generation and transportation and to support a once-in-a-century electricity transformation. The location of the Central-West Orana REZ will include the Project Site and will support the development of 2.1 GW of renewable energy, increasing to 7.7 GW by 2040 (AEMO 2022). To help facilitate this increase in renewable energy, considerable development is required within the transmission line infrastructure. As discussed in the Central-West Orana Transmission Link Scoping Report (EnergyCo 2022), the existing 330 kV and 132 kV transmission network is not capable of transferring three (3) or more GW of new electricity generation expected to be generated from the Central-West Orana REZ. Therefore, a new 500 kV transmission link is proposed, with SEARs for the project being provided in 2022.

The Project has been designed and located to take advantage of several factors, not just the abundance of wind energy but also its proximity to the exiting transmission network. The Project will connect to the existing 330 kV transmission link shown in Figure 1-2 and will allow the Project to begin delivering renewable energy to the grid as soon as the Project begins operation.

Further, the proposed Central-West Orana REZ Transmission Link (Burrendong Extension) (EnergyCo 2022) will develop a 500 kV transmission line from the existing networks near Merriwa and Wellington and extend south near Lake Burrendong (Figure 2-6, Transgrid 2023). The location of the Burrendong Extension of the Central-West Orana REZ transmission link is proposed near the Project Site which will provide additional network capacity, following completion. The Transmission Link will allow for the transfer of electricity across better equipped transmission lines to load centres throughout NSW.

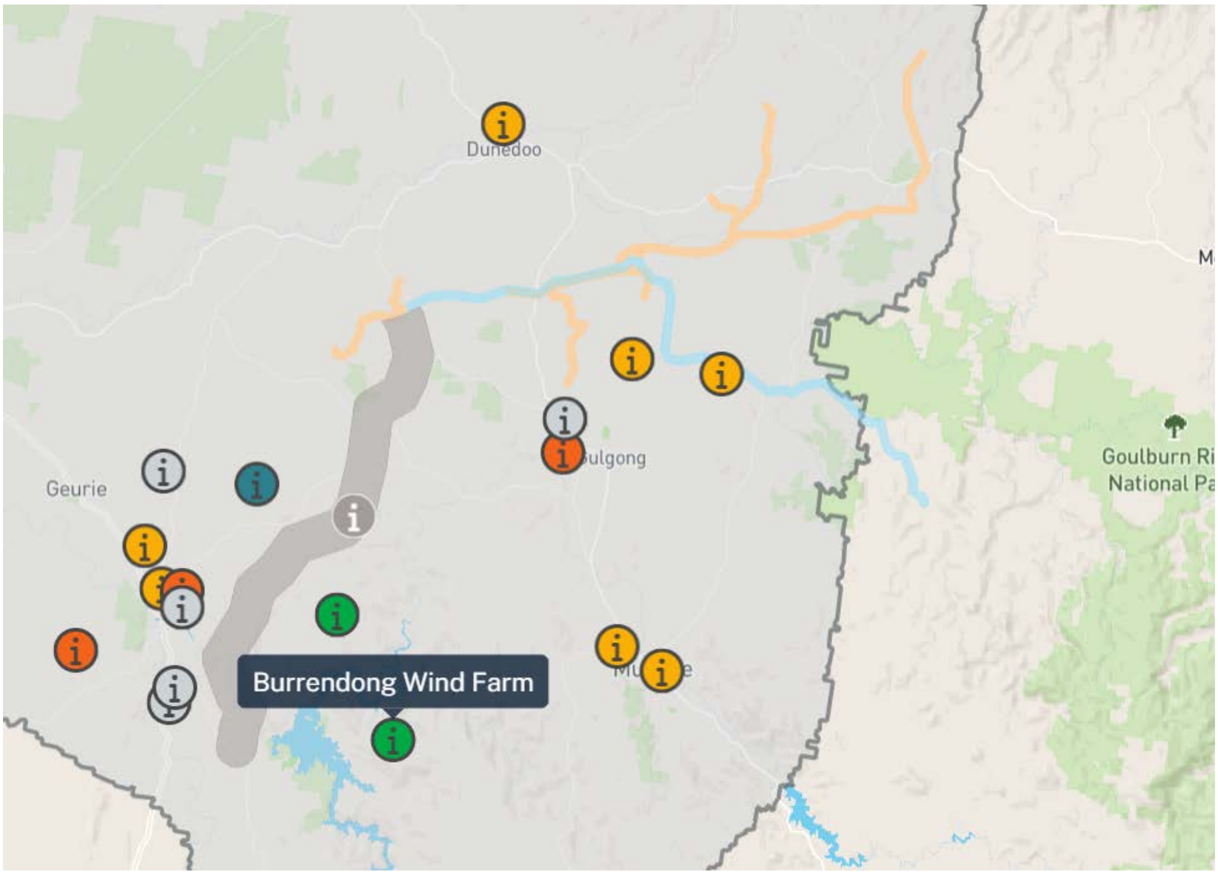


Figure 2-6: Proposed 500 kV (blue) and 330 kV (yellow) transmission corridors, as well as the proposed southern extension (grey) in relation to the Project (Transgrid Interactive Map, 2023)

2.3. Local and Regional Plans

2.3.1. Central West and Orana Regional Plan 2041

The Central West and Orana Regional Plan 2041 provides an updated blueprint for the region building upon the previous Central West and Orana Regional Plan 2036. The 2041 Plan continues important objectives set out in the 2036 Plan and provides updated objectives to make sure the character and identity of the region is celebrated and protected. With the consideration of climate change risk and its impacts on the region, the 2041 Plan incorporates the facilitation of renewable energy among the approaches taken to adapt to and mitigate climate change.

The Plan reinforced the significant potential of the region for renewable energy projects with vast open spaces and elevated tablelands suitable to wind energy. The Project will seek consent to develop a wind farm that will assist in delivering the following objectives set out in the plan:

- *Objective 3:* Plan for resilient places and communities by providing a clean renewable energy source in the region.
- *Objective 13*: Protect agricultural production values and promote agricultural innovation, sustainability, and value-add opportunities by diversifying revenue streams for involved landowners on agricultural lands.
- *Objective 20*: Leverage the Central-West Orana Renewable Energy Zone to provide economic benefit to communities by providing jobs, stimulating local economies.

The Central-West Orana Regional Plan 2041 also builds on 19 Local Strategic Planning Statements (LSPSs) to ensure the region's ongoing prosperity by providing a robust, up to date strategic framework.

2.3.2. Dubbo and Mid-Western Local Strategic Planning Statements

Both the Dubbo Regional Council and Mid-Western Regional Council LSPSs plans for the economic, social, and environmental land use needs for their communities. As the Project Site falls within both LGAs, the two LSPSs apply. These planning statements set out land use planning priorities to ensure that future development within the respective LGA is appropriate for the local context.

2.3.2.1. Dubbo LSPS

The Dubbo LSPS sets out 4 main themes to deliver on their vision of becoming a "key strategic centre, to be a place with a strong community spirit, a key centre for economic activity and a centre for education and the servicing of a significant population" (DRC 2020). The Project will assist in delivering on the Dubbo Council vision for the future by specifically addressing the Planning Priorities described in Table 2-2.

Table 2-2: Dubbo LSPS planning priorities addressed by the Project

Planning Priority	Relevance to the Project
1: Plan for the delivery of infrastructure to support growth	The Project will generate 400-500 MW of electricity, which can provide the average annual electricity needs for over 247,000 NSW households and will be essential in providing additional energy generation for a growing region.
3: Promote Renewable Energy generation	The Project will see the development of large-scale renewable energy generation within the Central-West Orana region in a way that seeks to minimise impacts to productive agricultural lands. The Project has been designed to avoid areas of high productivity where possible and will allow for the majority of the Project Site to remain agriculturally useful.
5: Protect and enhance our agricultural industries and agribusiness	The development of the Project will involve temporary modification of land use of up to 3,058.08 ha, accounting for 0.01% of all land used for agriculture in the ABARES Far West and Orana Region. While the construction period will see a temporary reduction of land use, during the operational phase of the Project, most existing agricultural activities will continue due to the relatively small footprint of individual WTGs.
18: Develop resilience to climate change	Located in regional NSW, the Central-West Orana region is continuing to feel the effects of increased heat due to climate change. Climate modelling predicts severe increases in temperatures within the coming decades because of continued burning of fossil fuels. One of the best ways to combat climate change is to develop renewable energy that can displace the emissions generated from fossil fuels and limit further warming. Renewable energy generation such as the Project will be an essential element in rural communities developing resilience to climate change.

2.3.2.2. Mid-Western LSPS

The Mid-Western LSPS sets out 3 main themes to deliver on their vision "to provide for sustainable growth and development, having regard to the Region's unique heritage, environment and rural character, and to support agricultural enterprises and the Region's economic base" (MWRC 2020). The Project will assist in delivering on the Dubbo Regional Council vision for the future by specifically addressing the Planning Priorities described in

Table 2-3: Midwestern LSPS planning priorities addressed by the Project

Planning Priority	Relevance to the Project
4: Provide infrastructure and services to cater for the current and future needs of our community.	The development of the Projects proposed 400-500 MW wind farm will be able to generate the average annual electricity needs for over 247,000 NSW households and will be essential in providing additional energy generation for a growing region. The addition of the Project to the regional energy supply will help future proof energy needs in a prospering region.
5: Ensure land use planning and management enhances and protects biodiversity and natural heritage.	The Project Site was selected due to its suitability for a wind farm based upon the available wind resource within the Project Site and the initial environmental and social constraints identified through preliminary investigations. The proposed Project layout is the result of comprehensive modelling, investigations, and consultation and has been chosen partly to reduce impacts on native vegetation, flora, and fauna. Impacts to ecological values have been minimised by: • Avoiding areas of high conservation value and/or native vegetation, where possible. • Minimising the amount of land disturbance needed for Project elements. • Utilising previously disturbed land for Project elements. The Project Site has been developed so that the Development Footprint (approximately 781 ha) can be micro-sited to avoid and reduce impacts to native vegetation, flora, and fauna. The location of roads, tracks, placement of WTGs and powerline connection corridors will also be micro-sited to minimise impacts. Additional surveys will be undertaken to ensure impacts will be avoided where possible, or minimised.
8: Provide leadership on economic development initiatives and identify resources and infrastructure required to drive investment and economic growth in the Region.	The development of the Project is set to occur within the NSW Central-West Orana REZ which will make up part of an estimated 3GW of renewable energy generation. The inclusion of the Project within this REZ will assist in facilitating the development of essential energy infrastructure throughout the region while also driving economic growth and investment.

2.3.3. NSW Wind Energy Guidelines

The Wind Energy Guidelines (DPE 2016a) seek to provide general guidance and regulation on the planning framework for the assessment and determination of large-scale SSD wind energy projects within NSW.

The objectives of the Wind Energy Guidelines (DPE, 2016a) are to:

a. *provide clear and consistent guidance to the community, industry and regulators about how to measure and assess key environmental impacts of SSD wind energy development in NSW;*
b. *facilitate better outcomes by requiring early identification of impacts to drive better siting and design;*
c. *facilitate meaningful, respectful and effective community and stakeholder engagement across the development assessment process, from pre-lodgement to post-approval;*
d. *encourage benefit-sharing between wind energy operators and the communities in which they operate, where appropriate; and*
e. *provide greater accountability for the management of impacts over the life of a project by linking commitments to conditions and / or appropriate monitoring and adaptive management strategies.*

The Project has been developed in accordance with the typical assessment and approval processes of SSD. The Wind Energy Guidelines (DPE 2016a) which were developed by DPE, specifically for large scale wind energy projects, outline the environmental issues relevant to wind energy developments that must be considered in the environmental assessment. These issues have subsequently been included in the SEARs for the Project, dated 30 September 2022, and include strategic context (compliance with climate change policies and RETs), visual and landscape, noise and vibration, biodiversity, traffic and transport, hazards and risk, heritage, water, and soils, waste, and socio-economic impacts, decommissioning and cumulative impacts.

The Wind Energy Guidelines (DPE 2016a) have been an integral component in the development of the Project and each of the environmental assessment requirements are addressed by the Proponent. The Project complies with and is consistent with the requirements of the Guidelines to ensure coherence with the SEARs as well as other relevant Plans and Policies pertaining to large scale wind farm developments.

2.4. Justification of the Project

2.4.1. Wind Power as a Competitive Energy Source

2.4.1.1. Interaction with the Electricity Market

New South Wales has historically relied on coal-fired energy for the delivery of electricity across the state. The Australian Energy Market Operator (AEMO) released their 2022 Integrated System Plan (ISP), discussing the shifting landscape within the NEM and sources of energy generation within NSW and across the country. The ISP notes the '*once-in-a-century transformation in the way electricity is generated*' and highlights the impact of technical innovations in wind and solar on the electricity market. The reliance on coal-fired generation presents a challenge in the coming years as most NSW coal generators are set to retire, requiring an additional 19 GW of dispatchable energy to be supplied by alternative sources (Figure 2-7). As the largest consumer of electricity in the NEM, NSW faces a particular challenge with the impending retirement of coal-plants such as Liddell, Vales Point and Eraring. The urgency for this transition is further highlighted by the announcement of Origin Energy's Eraring facility now proposed to close seven (7) years earlier than previously planned, likely by 2025, as well as AGL announcing earlier in 2022 that they will be closing Australia's most emissions intensive power station, Loy Yang A coal power station (Climate Council 2022). To cover the energy loss from earlier coal plant retirements, it is estimated that there will need to be a minimum of 2,850 MW of extra wind power generation (Whitlock 2022).

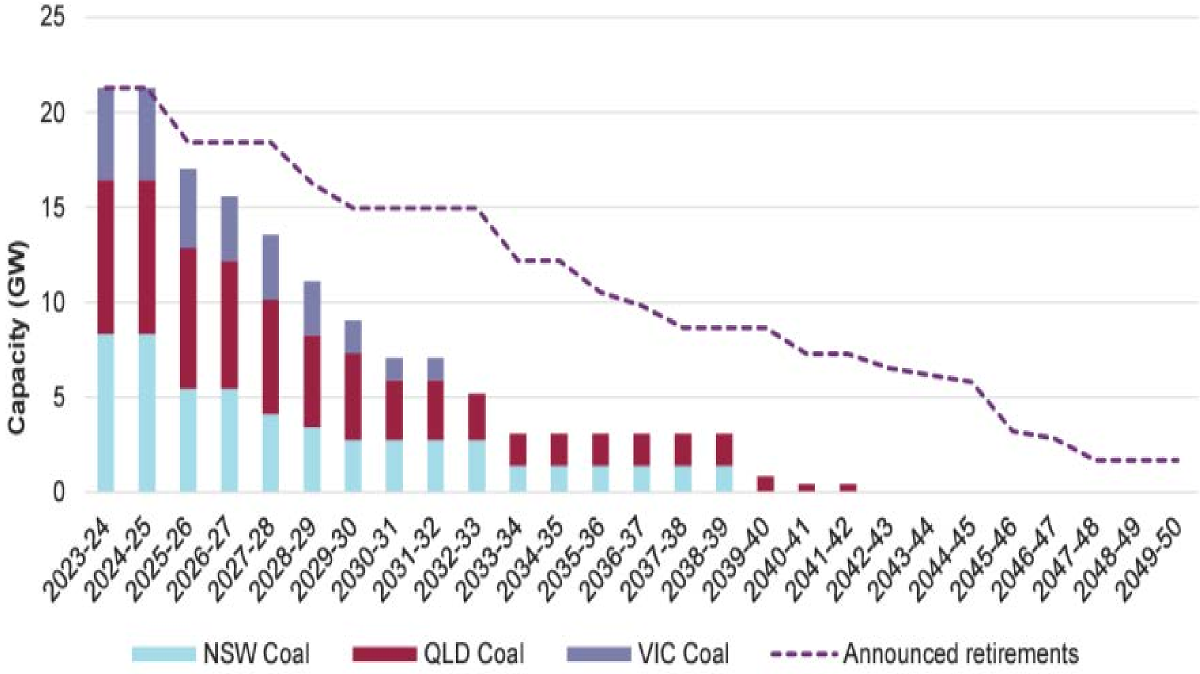


Figure 2-7: Forecast coal plant retirements (AEMO, 2022)

Therefore, the Project is well placed to help alleviate the oncoming shortfall in energy generation capacity and provide readily dispatchable energy where needed into the grid by adding an additional 400-500 MW to the NEM. This alleviation, much like many modern wind farm projects, is provided by the ability of the Project to generate and store energy to be provided to the grid in a highly dispatchable way. The Project will maximise the generating capacity of the WTGs and help close the gap left by shuttering coal plants. In challenge comes opportunity, as the reduction in supply of energy from closed coal plants presents an opportunity for NSW to develop a cleaner, more integrated, renewable energy network for the future. The AEMO highlights the importance of developing resource diversity across the NEM to reduce the need for firming and dispatchable resources, as well as reducing the volatility associated with weather-powered energy systems such as wind power. The development of large-scale renewable energy developments, such as the Project, are essential in diversifying the electricity market and meeting the variable daily and seasonal energy demands.

The NSW Electricity Infrastructure Roadmap plans on capitalising on that opportunity by '*transforming the electricity system into one that is cheap, clean and reliable*' (DPIE 2020). The implementation of the Roadmap lays the foundation for considerable investment and job creation in regional NSW while also addressing electricity affordability. The AEMO anticipated that through the 2020s, increasing wind capacity will complement the existing strong uptake of distributed solar, with wind energy expected to represent 85% of all additional renewable energy projects outlined in the Step Change Scenario (AEMO 2022).

2.4.1.2. Suitability of Wind Power

Harnessing wind power to generate clean, renewable energy has evolved significantly over the last 30 years into an efficient, competitive, and mature energy generation technology. This technology continues to evolve and improve, with worldwide installed wind capacity having increased over 115% between 2015 and 2022 (Figure 2-8) (WWEA 2022). Wind power statistics published by the World Wind Energy Association (WWEA) indicate that the world set a record for new wind power installations in

2020, adding 93 Gigawatts (GW). This record has been broken consecutively in 2021 and 2022, adding an additional 97 GW and 116 GW[3] respectively (WWEA 2021; WWEA 2022). It is expected that by the end of 2022, there will be a total installed capacity of 955.84 GW globally.

The continued upward trend in new wind installations reinforces the apparent appetite for wind energy generation as a viable energy source. Increasing installed capacity highlights that wind energy is well positioned to meet future global and national demand for electricity, as it possesses one of the lowest production costs, uses no water during electricity production and is a mature technology acceptable to energy utilities. This is reinforced by the continued growth in the share of electricity generation in the NEM, with the Clean Energy Council showing wind energy representing 11.7% of all electricity generated annually, up from 7.4% in 2020 (CEC 2022).

The investment in and performance of wind power has demonstrated its position as an affordable, reliable, and clean energy source. Technological improvements in the industry will further support the growing role of wind power in Australia. This is further demonstrated in the decreasing Levelised Cost of Energy (LCOE) to produce wind energy and the continuing improvements in reliability of wind power further explained below.

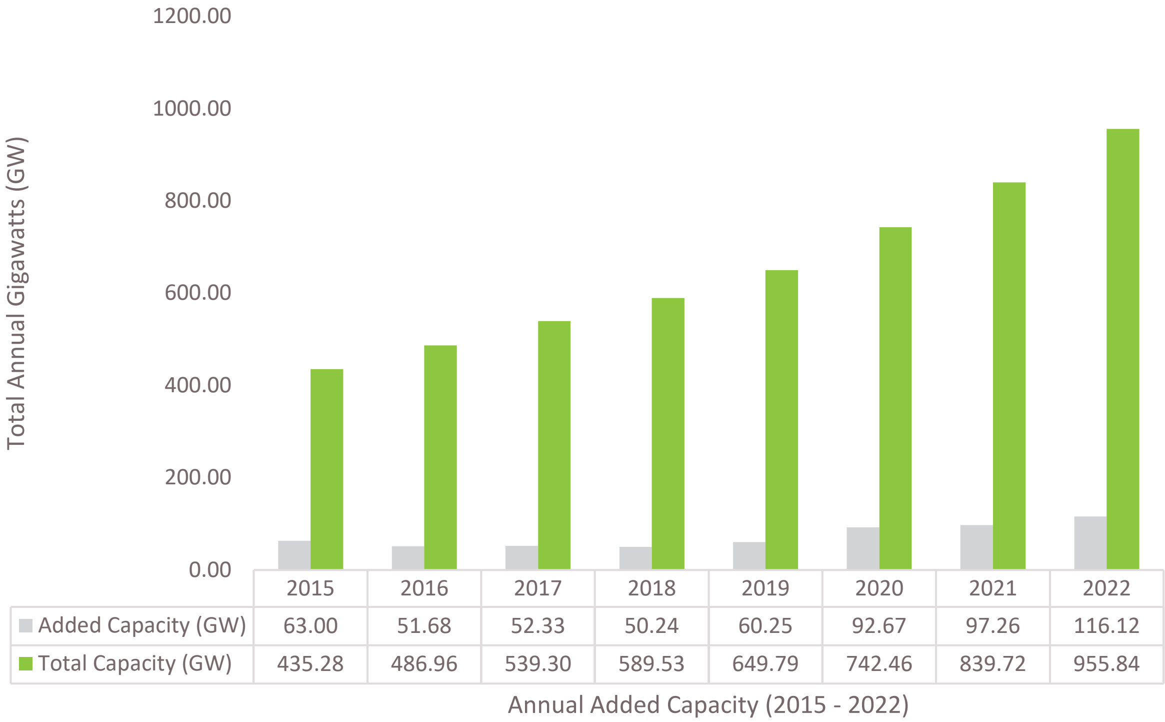


Figure 2-8: Total cumulative installed wind capacity 2015-2021 (WWEA, 2022)

[3] The figures for total added wind capacity in 2022 by WWEA demonstrate the predicted installations by the end of 2022. Total installed capacity as of June 2022 globally was 874.18 GW.

2.4.1.3. Levelised Cost of Energy

The cost of wind generation technology has fallen dramatically over the past decade as the total installed annual wind capacity has increased (Figure 2-8). Notably, the evolution of Australia's electricity system has resulted in solar and wind energy currently providing the cheapest sources of new bulk electricity supply (CSIRO 2021). Over the past decade, prices of wind farms have reduced by 55-60%, primarily due to reduced installation costs, while expanding hub heights and swept areas (which boost capacity factors), reducing operation and maintenance (O&M) costs (IRENA 2021).

A common metric used to directly compare energy generation technologies is calculating their LCOE. The LCOE includes the capital costs, operating costs and maintenance costs associated with the lifetime of a Project, considering the cost from 'cradle to grave'. The global weighted average LCOE of wind energy generation fell 72% between 2009 and 2021, from USD $0.311/kWh to USD $0.041/kWh (IRENA 2021; Lazard 2021). This was driven mainly by the reduction in WTG costs and improvements in wind generation technology efficiency to allow more electricity to be harvested at lower wind sites and speeds (IRENA 2021).

The GenCost 2021 report, a collaboration between CSIRO and AEMO, provides a transparent and coordinated approach to updating Australia's electricity generation costs annually. The report indicates that the LCOE of wind generation is continuing to fall as larger, more efficient WTGs enter the Australian market. Figure 2-9 shows the LCOE for a range of generation technologies including standalone generation and 'firmed' wind energy including two storage options, battery and pumped hydro energy storage. The figure demonstrates that the LCOE of wind energy, is now the cheapest form of energy to produce. Furthermore, the carbon emissions payback period of a WTG is estimated at a period of six (6) to nine (9) months. This is due to the zero emissions produced to generate energy from the WTG. Considered in tandem, the production of wind energy presents a cheap and low emissions option to generating electricity for the grid (Thomson & Harrison 2015).

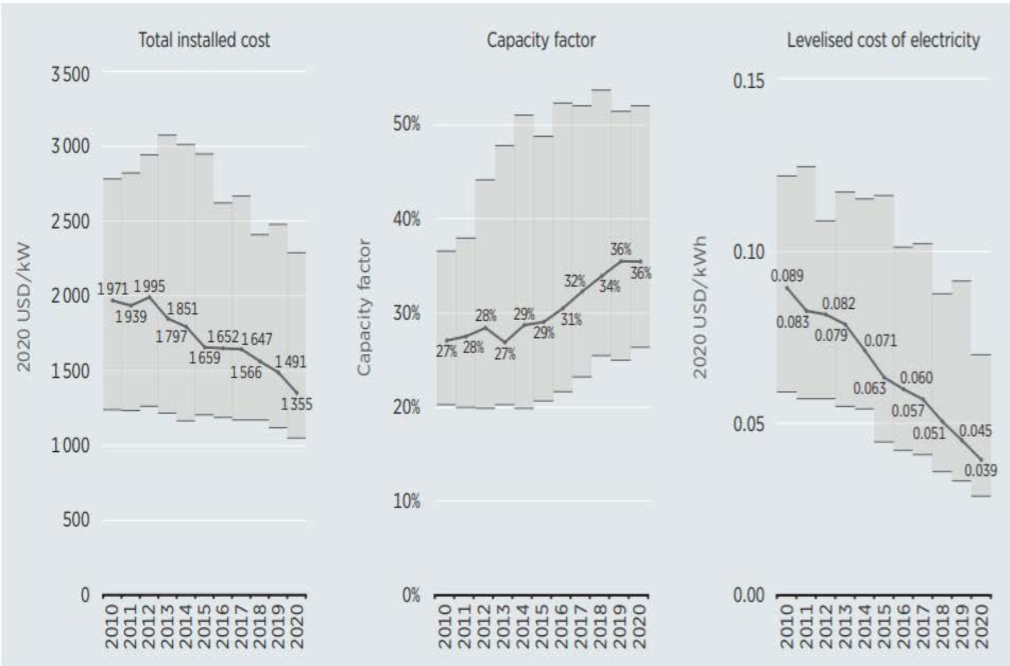


Figure 2-9: Global weighted-average total installed costs, capacity factors and LCOE for onshore wind, 2010-2020 (IRENA 2021)

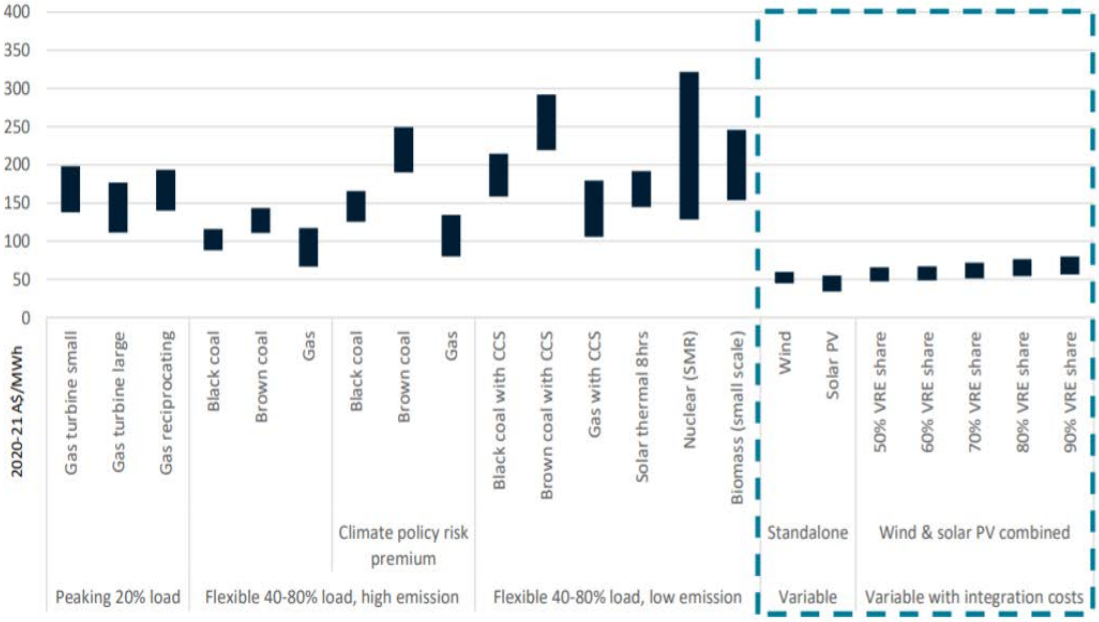


Figure 2-10: Calculated LCOE by technology and category for 2030 (CSIRO 2021)

2.4.1.4. Technological Advancements

Public debate regarding renewable energy generation has primarily centred around two issues: reliability and dispatchability. Reliability is a function of the overall market and the balance between supply and demand, not just the actions of new entrant generators. Dispatchable generation refers to sources of electricity that can be dispatched on demand at the request of the grid operators.

Increasing the number of wind and solar generation facilities does not threaten reliability of the grid when developed in a way that ensures appropriate infrastructure is provided to support intermittency. This includes investors responding to market requirements and building sufficient dispatchable generation such as battery storage. This is particularly important when existing electricity generators are retired, causing a sudden drop in available generation capacity. Wind technology, both on and offshore, has a high energy return on energy invested compared to existing conventional energy sources, such as coal. Due to this, the requirement to harness the wind more effectively has helped to drive the evolution of wind technology. Generally, wind generation is considered non-dispatchable. Therefore, improving dispatchability would permit time shifting of wind power dispatched to the electricity grid, enabling wind generators to supply baseload power, exploit energy arbitrage (purchasing more electricity during off-peak periods) and providing ancillary services.

Major improvements in the sustainability of wind turbine components have also occurred in recent years. WTG manufacturer Siemens states the 85% of WTGs are already recyclable (Vorrath 2021). Furthermore, the Danish wind turbine manufacturer LM Wind announced that by 2030, they will begin producing zero waste turbines, in part to further reduce the CO_2 emissions resulting from the wind turbine supply chain (Hill 2021). Similarly, wind turbine manufacturer, RecyclableBlade, announced a further step in their path towards fully recyclable wind turbines by 2040. This will be done through their novel approach to separating the resin which has traditionally made it difficult to fully recycle turbines (Vorrath 2021).

Continued improvements in WTG technology, wind farm siting and reliability have led to an increase in average capacity factors, with the global weighted average wind capacity for a WTG increasing from 27% in 2010 to 36% in 2020 (IRENA 2021). Technology improvements, such as higher hub heights, larger turbines and swept blade areas mean contemporary wind turbines can achieve higher capacity factors from the same wind site than their smaller predecessors.

WTGs are available in various sizes depending on a variety of factors including use and location. Figure 2-11 below provides a timeline of the change in size of WTGs from the 1990s to the present. The dimensions of the WTGs anticipated to be available in Australia in the next few years are currently under review and WTGs up to 250 m (height from ground to top of blade tip), with generating capacity expected to be upwards of 6-7 MW, are being considered for the Project.

Larger WTGs enable greater energy generation from a smaller number of machines, lowering the LCOE. A decrease in the number of resources used to produce the machines in turn reduces the major source of emissions in WTG production, the manufacturing stage, therefore reducing the CO2-e/kWH of the turbines and Project overall. Larger and more efficient turbines are also able to take advantage of advancements in battery storage technology, increasing the reliability and dispatchability of the WTGs.

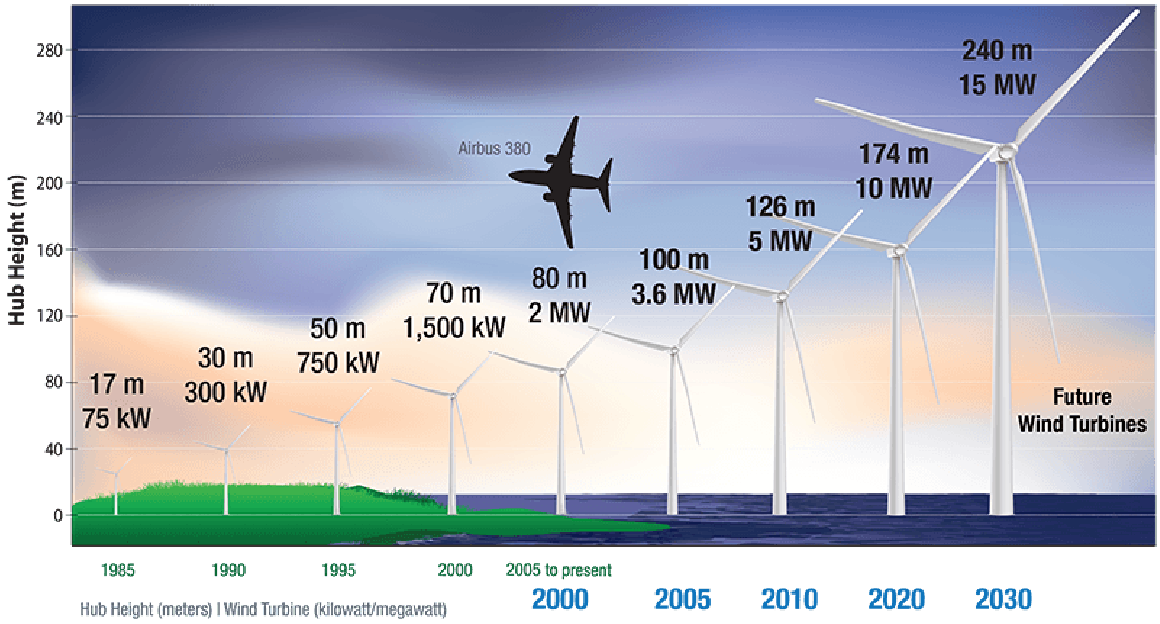


Figure 2-11: Growth and future growth in capacity and rotor diameter of WTGs (1990 – 2035) (DoE 2021)

2.4.1.5. Life Cycle Assessment

A Life Cycle Assessment (LCA) is a technique used in assessing the environmental aspects associated with a product over its total life cycle, from 'gradle to grave' (Muraliskrishna, Manickam 2017). This assessment approach is extremely useful in understanding the overall impacts associated with various energy generation types, such as wind and coal. Numerous LCAs have been undertaken for wind farms to understand the direct emissions from wind farm construction, operation, and decommissioning, as well as the environmental impacts associated with resource requirements for the lifetime of the Project. The life cycle stages of wind energy include manufacturing, construction, operation, and end of life. Where electricity generated by burning coal generated considerable CO2-e emissions both in the development and operational phases, wind energy generates zero emissions in the production of electricity.

The production of emissions associated with energy is often demonstrated in the CO2-e generated per kilowatt hour produced (hereafter referred to as CO2-e/kWH). For this EIS, the Vestas V112-3.3 MW WTG is used as an example WTG, given Vestas considerable background in WTG infrastructure. Vestas notes the carbon footprint associated with their V112-3.3 MW WTGs is 5.9 g CO2-e/kWH, compared to the 14 g CO2-e/kWH demonstrated in Figure 2-12 (Vestas 2017). Should the Project assume an average between the two emissions estimates of 9.95 g CO2-e/kWH produced by wind energy, the emissions associated would remain considerably lower than all forms of fossil fuels in their emissions per kilowatt hour, with the carbon intensity of coal considered approximately 1 kg CO2-e/kWH (Wilson 2013).

It is noted that that the Proponent has not yet committed to a specific WTG model or manufacturer. However, the Vestas V112-3.3 MW WTG provides a clear example of the lower embedded emissions associated with wind energy compared to fossil fuels.

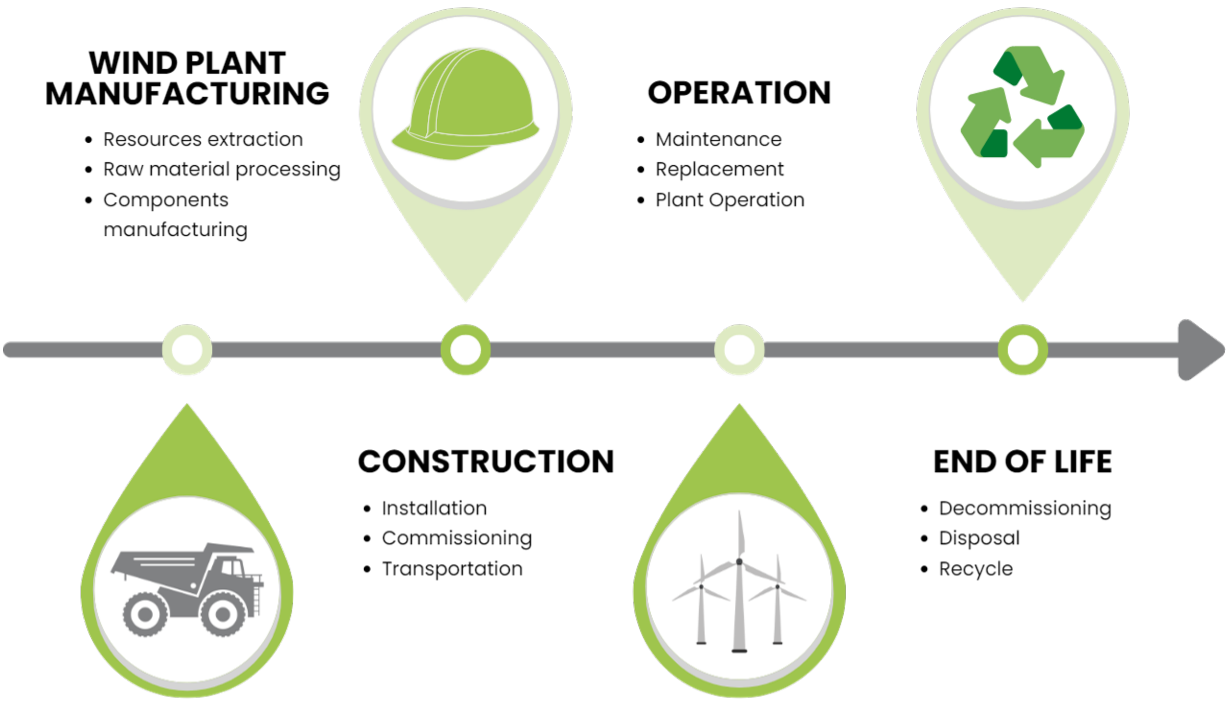


Figure 2-12: Life Cycle Assessment Stages of Wind Energy (Bhandari et al 2020)

The majority of the environmental impacts associated with the life cycle of a wind farm occurs during the manufacturing stage and the transportation stage. This is a result of the energy and materials requirements to produce the WTG components such as blades, nacelle, and towers. Additionally, the transportation of those materials, often shipped to Australia and then transported by road, contains embedded emissions associated with the ship and truck movements (Vestas 2019). In general, the parts of the WTG that contribute most significantly to environmental impacts are the largest metal parts within the WTG as discussed above. However, in comparison to other forms of energy such as coal, gas, and even solar energy, onshore wind farms have the lowest carbon intensities associated with energy generation, as seen in Figure 2-12.

In general, the time it takes for a WTG to repay the energy used in construction and transportation ranges from five (5) to eight (8) months (Vestas 2021; Peach 2021; Guezuraga, Zauner, Pölz 2012; Martinez et al. 2009). That is to say that on average, it takes a WTG five (5) to eight (8) months to generate the equivalent energy that it took to manufacture and transport the components, with the energy produced afterwards considered zero emissions. The carbon payback period is dependent on the carbon intensity of the manufacturing process and the electricity displaced by the operational WTG, therefore making it difficult to provide an exact figure. Manufacturing has the largest impact upon carbon emission production, with energy consumed during manufacturing balanced by energy saved from the recycling of components following decommissioning (Martinez et al. 2009; Tremeac & Meunier 2009).

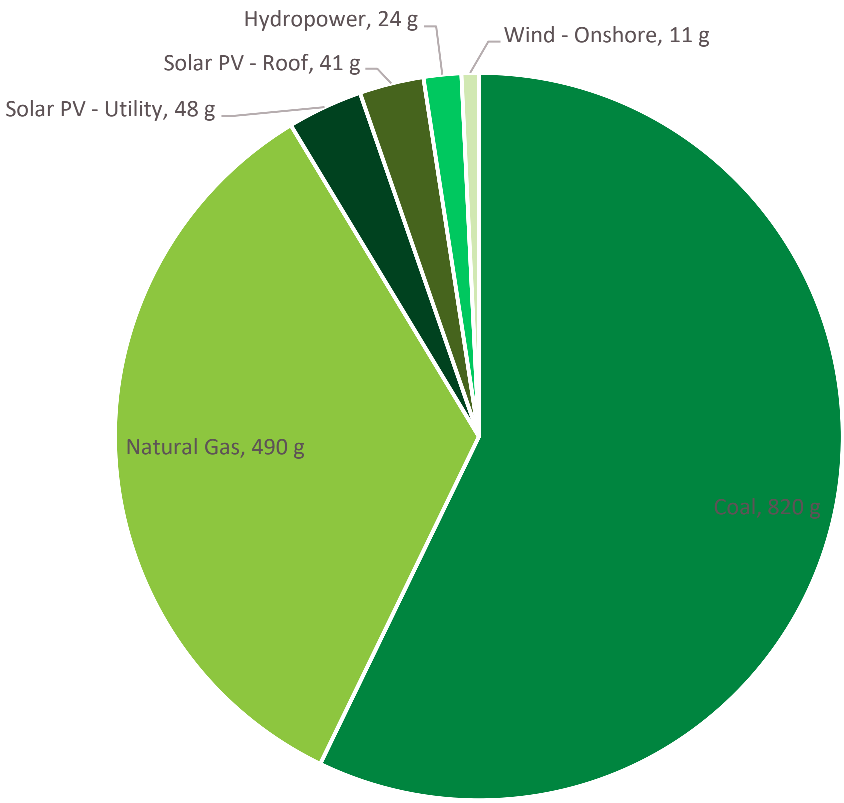


Figure 2-13: Average life-cycle grams of CO2-e emissions by generation source (WEA, 2022)

2.4.1.6. Social Cost of Carbon

The urgent need for renewable energy limits the negative social costs of burning fossil fuels and the climate crisis. Policy debates often focuses on ways to mitigate the impacts of climate change, where the social cost of carbon (SCC) attempts to estimate the economic costs of climate change. Usually estimated using the net present value of climate change impacts over the next 100 years from the addition of an additional one (1) tonne of carbon emitted into the atmosphere, the SCC puts a dollar value on the cost of every tonne of CO_2-e emitted (Watkiss 2003). From there, the 'cost of climate change' to economies over the coming decades can be forecast.

The U.S. Environmental Protection Agency has recently proposed a new estimated social cost of carbon, costing $190USD per tonne, increased from $51USD per tonne. For the annual reporting period of 2020, Ritchie and Roser (2022) estimated that global CO_2-e emissions from fossil fuels and industry reached 37 billion tonnes. While previous estimates put the social cost of annual emissions at $1.92 trillion USD, the updated estimate puts the cost emitting CO_2-e at $7 trillion USD, per year. Therefore, the cost of responding to climate change due to carbon emissions will be expensive.

Contrasted with the cost of continued reliance on oil, gas and coal, a rapid transition to renewable energy is forecast to globally save up to $15 trillion dollars in modelling run between 2021 and 2070. This is due to improved useful energy outputs and reduced costs of renewable energy production (Way *et al.* 2022). This is true even if climate change were not taken into account, as this figure does not account for the social cost of carbon damages.

2.4.2. Site Selection – Land Suitability

A range of factors are considered during the 'site selection' phase. These factors affect the suitability of an area for a wind farm and may potentially constrain development and include:

- Suitability of the wind resource.
- Ease of connecting to and capacity of the local electricity transmission network.
- Site access and general ground conditions, including slope and geology.
- Proximity to residential properties and the nature of surrounding land uses.
- Availability of WTG sites based on a range of constraints.
- Presence (or absence) of nationally and locally significant areas regarding environment, landscape, nature conservation, archaeology, and cultural heritage.
- Interest within the community.

Further decisions around alternative design related to the Project will be made post-approval during detailed design. The goal will be to minimise environmental and social impacts while maintaining investment viability. This decision-making will occur within the approved Development Corridor, rather than at a macro scale (i.e., site identification/selection).

2.4.2.1. Wind Resource

Numerous investigations into the wind resource potential at several locations across NSW have revealed some general principles that can be applied to assess the merit of an individual site's wind resource. Wind speeds were found to be likely to be adequate in areas that are:

- Exposed to open water or large areas of open grassland without intervening obstructions. These areas receive a very smooth airflow with a high-energy content.
- On significantly elevated locations, surrounded by a smooth and gently rounded landscape, thus promoting wind speed-up. The hills and ranges that make up the Project area offer excellent speed-up due to topographical detail.

The Proponent has been monitoring the wind resource at the Project site using on-site wind monitoring equipment since 2018. The monitoring data has been modelled with long term Bureau of Meteorology (BoM) data from the local area and shows wind speeds that are high and consistent making this Project viable in the selected location.

2.4.2.2. Land Use

The Project is in a predominantly agricultural area and there is a very low population density within and around the Project. The small township of Hargraves is located approximately 12 km east of the Project Site and has a population of 300 people as of the 2021 census (ABS, 2021). The township of Gobarralong is located approximately 8 km east of the Project Site and has a population of 96 as of the 2021 Census (ABS, 2021b). Several other rural communities are present within a 20 km radius of the Site including:

- Yarragal
- Worlds End
- Mookerawa
- Stuart Town
- Mumbil.

Other than potential disruption during construction, the Project would not significantly affect the strategic land use objectives of agriculture in the long term. Only a small percentage (10.6%) of the Project Site would be used to support infrastructure for the Project, of which 97.3% has been determined to have severe to extremely severe land capability limitations (LSC Classes 6 and 7).

A section in the northwest of the Project Site is mapped as Biophysical Strategic Agricultural Land (BSAL) following the Macquarie River. The Project Site is located on approximately 258 ha of BSAL, of which 20.80 ha is located within the Development Corridor and 3.40 ha is within the Development Footprint (Figure 6-55). This is further discussed in Section 6.10.

2.4.2.3. Electricity Transmission Network

Ease of connection to and capacity within the grid can initially be difficult to assess given the commercially confidential nature of information concerning electricity distribution and transmission networks, coupled with the complexity and variety of connection options that may be available. However, the Project is near existing transmission lines and electrical connection points near Burrendong Dam, negating the need to construct a new, large transmission corridor. Initial project assessments undertaken by the Proponent in consultation with TransGrid demonstrate both an ability to connect the Project to the grid and the capacity within to accommodate the additional energy generated. The existing transmission lines are near the Project Site, and the electrical connection points for the Project are described in Section 3.2.3.3.

2.4.2.4. Site Access and Condition

There is good road access to the Project Site. Several sealed minor roads and numerous unsealed, graded minor roads intersect the Project Site. These roads connect to sealed secondary roads, with flow-on access to state and Federal Highways.

Within the Project Site the land is very remote and rugged with difficult access for landowners and emergency services. The proposed Internal Roads throughout the Project Site will be beneficial for landowner use and emergency services. Internal Roads have been designed and located in close consultation with landowners.

The construction of the Project also has potential benefits in tackling bushfires which occur in the region, including improved access from new tracks, on-site Internal Roads, fire breaks and reduced lightning strike to vegetation.

2.4.2.5. Stakeholder Consultation

The development of a wind farm project must factor in landowner interests when determining the location of WTGs. A wind farm is unlikely to be placed on land where a landowner is resistant to the development. As such, stakeholder consultation is essential in understanding the appropriate WTG location from a social standpoint. Ark Energy has undertaken considerable consultation with landowners, ultimately helping to inform the project design and WTG placement in conjunction with other environmental factors. It is important to note that the final layout of the Project is subject to detailed design following project approval.

The Project design has changed extensively as a response to community feedback, land use changes, visual and noise impact studies, environmental investigations, market dynamics and WTG technological advancements. The design iterations and an explanation of the reasons for mitigation are summarised in Section 2.5. Further adjustment of the WTG locations is anticipated to occur in response to further stakeholder consultation and during detailed design. Access routes will be designed to achieve practical transport paths that minimise disruption to local traffic and environmental impacts. Initial options are currently being reviewed in preparation for consultation with Councils, landowners, and local road users.

2.4.3. Community Support and Benefits

As outlined within the Wind Energy Guidelines (DPE 2016a), both the Proponent and decision-maker are required to consider the public interest of the Project, which includes consideration of the objects of the EP&A Act and the principles of ESD.

The NSW Office of Environment and Heritage (OEH) commissioned Newspoll to conduct telephone interviews to study the awareness and attitude of communities to renewable energy, in particular wind and solar farms, across NSW over August and September 2014. A total of 2,000 people aged 18 and over were surveyed and the key findings of the survey report included (OEH 2015):

- Overwhelming support for the use of renewable energy across NSW. Nine out of 10 respondents strongly supported (49%) or supported (43%) electricity generation from renewables.
- Eighty-three per cent of survey respondents wanted more electricity generated from renewable sources over the next 5 years.
- Most respondents were aware of solar and wind as renewable energy technologies.
- Most respondents outside of metro areas supported the development of wind (59%) and solar (78%) farms, even close to home.

An analysis by Lothian (2020) reviewed survey data from multiple sources to understand the community acceptance of wind farms and their visual impacts in Australia. The analysis utilised survey data from the survey described above, along with numerous sources such as a ReachTEL survey conducted in 2018

(Greenpeace 2018), which found that 62% of respondents thought Australia should switch to wind and solar power. The analysis by Lothain (2020) aggregated the results of multiple surveys covering a total of 20,500 Australians which showed overall support for wind farms was 75%, with renewable energy more broadly enjoying 81% support, demonstrating a widespread support for wind power in Australia (Lothain 2020).

As part of the Social Impact Assessment (Ethos, 2023; Appendix S), the community was invited to participate in a community values survey and sought to gather feedback regarding the Project and understand community views. The social impacts identified by local landholders, community members and local councils included:

- Changes to views
- Noise impacts
- Community conflict
- Fear of environmental destruction
- Traffic impacts
- Health impacts
- Ability to influence decisions and be kept informed
- Property prices
- Impact to local economy
- Distributive equity
- Cumulative impacts in the REZ

The social benefits identified by engagement participants included:

- Employment
- Attracting new, long-term residents to the area
- Monetary gain for participating landholders
- The flow on benefits to local infrastructure
- Growth or renewable energy and addressing climate change

The Clean Energy Council's (CEC's) Guide to Benefit Sharing Options for Renewable Energy Projects (2019) provides strategies relating to various forms of benefit sharing to integrate renewable energy developments into local communities that are beneficial for both the Proponent and local communities. The Proponent has worked closely with the local community in accordance with the CEC's Guide (2019) to ensure there are mutually agreed opportunities for landowners, neighbours, and the wider community to share in the benefits of the development. The Proponent has proposed a community benefit fund of $3,000 per installed WTG per year administered through a voluntary planning agreement with local councils.

Community benefits of the Project have been identified at a global, regional, and local scale (DECCW 2010), including:

- Global Benefits:
  - The Project has the capacity to supply clean energy to power approximately 247,000 homes and, in the process, to reduce CO_2 emissions by over 900,000 tonnes per year.

- Regional Benefits:
  - Approximately 250 full time equivalent (FTE) jobs throughout the construction phase, with a peak of up to 375.
  - Approximately 12 direct FTE jobs, and 35 indirect FTE jobs throughout the operations phase
  - Improved security of electricity supply through diversification of regional generation sources and distribution of wind generators across the state.
  - This level of employment would equate to $120 million in wages (2023 dollars)
  - Indirect benefits to regional communities through increased labour demands and use of short-term accommodation.

- Local Benefits:
  - An estimated $21.4 million in wages (2023 dollars) would likely be directed to local and regional businesses and service providers during the construction period. This level of personal spending would help support approximately 53 FTE jobs in the services sector.
  - A community benefit fund to benefit the local area near the Project.
  - A Community Sponsorship Program with community members able to apply for sponsorship funding online or in person.
  - The anticipated $120 million in wages generated are expected to see a considerable portion to be spent regionally.
  - Voluntary Neighbour Agreements as recommended in both the Visual Bulletin (DPE 2016b) and the Clean Energy Council Guidelines (CEC 2018).

Impacts specific to landholders have been mitigated and managed through negotiated voluntary Neighbour Agreements. These agreements and impacts are discussed in Section 6.14.

The Project will play an important role in contributing to both the increasing local and global need for renewable projects to tackle the issues of global warming and climate change. The electricity generated and dispatched by the Project would result in significant carbon savings due to reduced reliance on coal powered generation. In a local sense, the installed capacity of 400-500 MW has the potential to provide sufficient renewable energy to support the annual electricity needs for 247,000 average NSW households, which represents approximately 7.4% of all NSW homes (Ethos Urban, 2023; Appendix T).

2.4.4. National Energy Market Capacity

The Project proposes to connect to the existing 330 kV transmission line to the west of the Project Site (Figure 1-2). The National Electricity Market (NEM) encompasses five states and a transmission network of approximately 40,000 km (AEMO, 2021) and is largely supplied by coal fired generators. To facilitate the transition towards renewable energy as the dominant supplier of energy in the NEM, significant changes are required to the transmission network. With a total electricity generating capacity of 65,252 MW (AEMO, 2021), Australia's grid connection network is physically long and thin and not designed to store and transport mass electricity generated from large-scale renewable energy projects. However, the Central West Transmission Project (of which the Burrendong extension is to the west of the Project Site), will increase the amount of renewable energy that can be delivered to consumers across the NEM, helping to facilitate the transition to a low carbon future. The Central West Transmission project will enable at least 3 GW of new network capacity to be unlocked.

2.5. Project Design and Alternative Options Considered

2.5.1. Project Site Selection and Design Evolution

The Project Site was selected due to its suitability for a wind farm based upon the available wind resource within the Project Site and the initial environmental and social constraints identified through preliminary investigations. Through the design of the Project and assessment of impacts, the following design hierarchy was adopted (Figure 2-14). In designing and assessing the potential impacts of the Project, the following design hierarchy was adopted:

- **Avoid**: In the first instance, all efforts were made to avoid potential environmental impacts.
- **Minimise**: Where potential impacts could not be avoided, design principles sought to minimise environmental impacts, as far as feasibly possible.
- **Mitigate**: Mitigation strategies will be implemented to manage the extent and severity of remaining environmental impacts.
- **Offset**: Environmental offsets shall be used only as applicable, following all efforts to first avoid, minimise and mitigate environmental impacts.

Figure 2-14: Design hierarchy of the Project

In addition, the following specific principles were adopted:

- **Minimise Vegetation Clearing:** Areas of high conservation value and/or native vegetation were strategically avoided.
- **Minimise Land Disturbance:** Design footprints for WTG hardstands, the Battery Storage, O&M compounds, Substations and Ancillary Infrastructure were limited to the minimum area required.
- **Protect Functional Riparian Zones:** Higher order (as per Strahler stream ordering) and higher value functional riparian zones were excluded from the developable area, where practical.

- **Use Previously Disturbed Land:** As much as possible the Project was located on land previously cleared of native vegetation by agricultural development.
- **Protect Cultural Heritage Values:** Through the identification and evaluation of cultural heritage assets at the Project Site.
- **Protect Agricultural Values:** Existing agricultural values will aim to be preserved and rent payable by the project shall offset forgone landholder income while providing consistent and diversified income streams for the duration of the project life.
- **Minimise Direct and Indirect Impacts:** As far as practicable, infrastructure will be located away from nearby residences and adjoining properties.

The Project has undertaken significant impact minimisation steps to reduce impacts raised during the environmental studies undertaken for the Project and consultation. The Proponent has been proactive in responding to the environmental studies and community feedback, with the Project design changing in response to community concerns, environmental constraints, market dynamics and WTG technological advancement. The Project Design evolution is summarised in Figure 2-15. A visualisation of which WTGs have been relocated or removed throughout this process is provided in Figure 2-16.

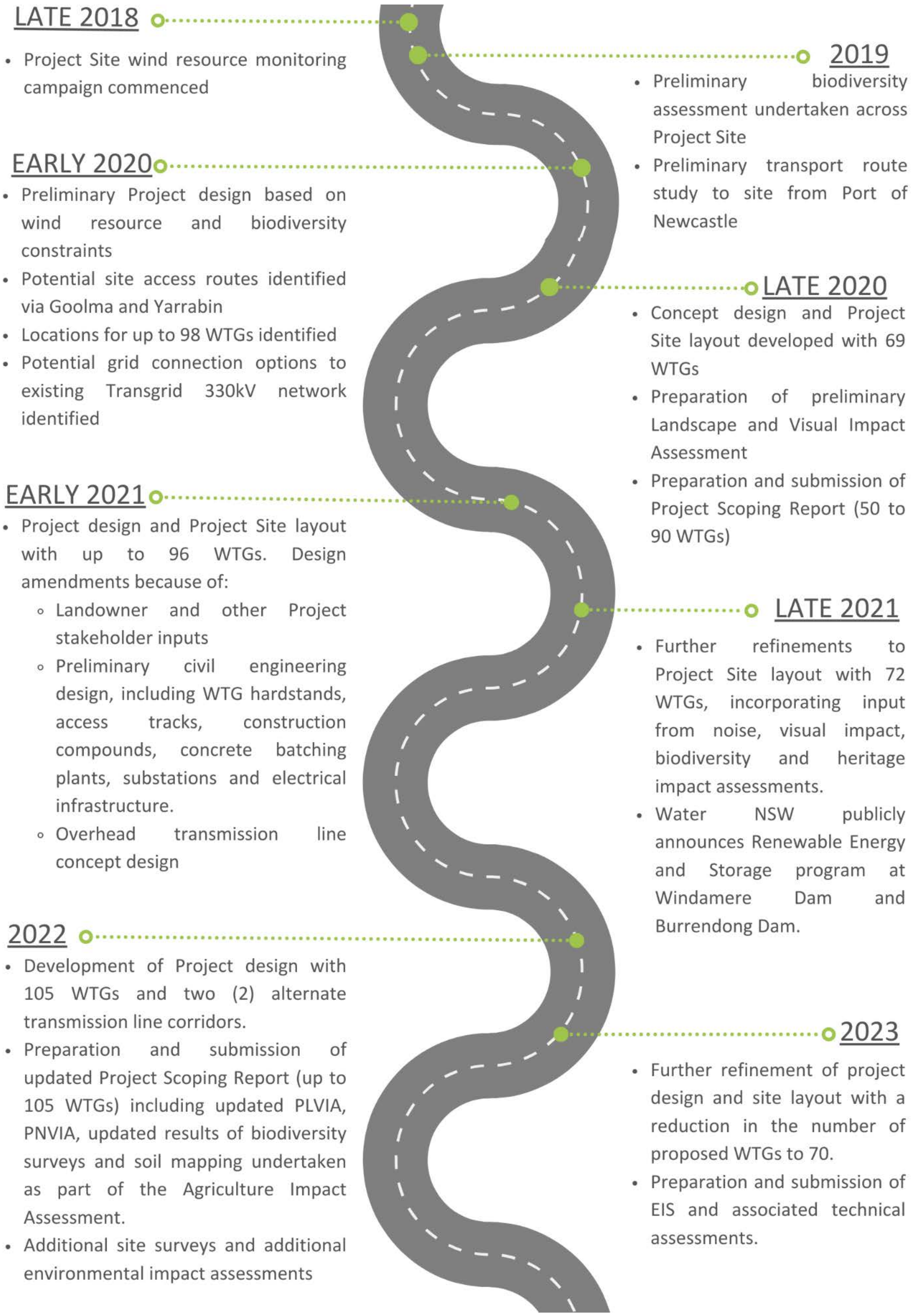


Figure 2-15: Project design evolution

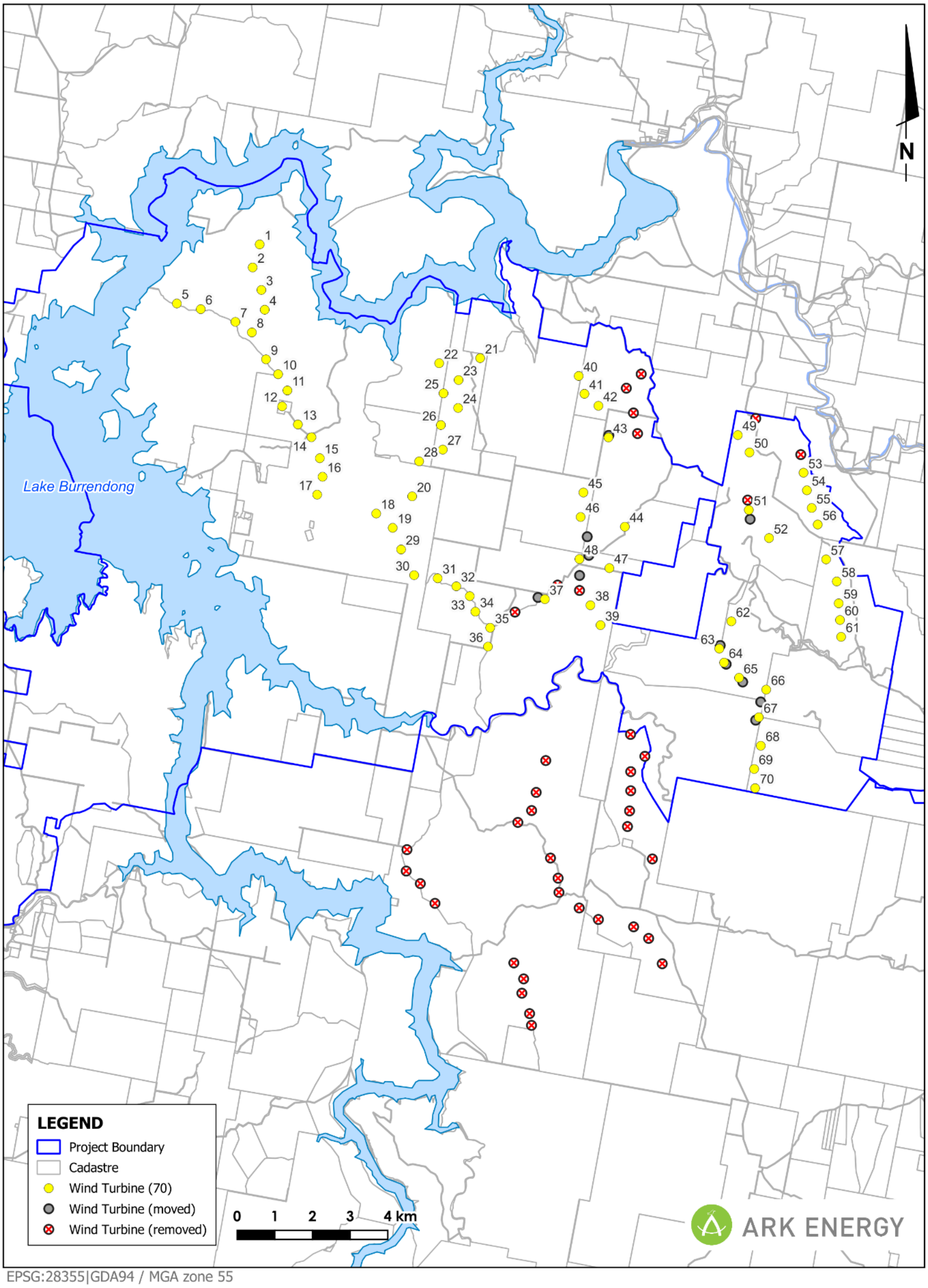


Figure 2-16: WTG design evolution

2.5.2. Alternative Options

The Proponent has evaluated a range of sites within the Central-West Orana REZ to connect to the NEM for wind generation opportunities, which may be considered as alternatives to the Project. Some of these sites have progressed as they are deemed appropriate developments, whilst other prospective sites have been considered, but discarded owing to a range of reasons.

The current Project design has been developed to minimise as much as possible the environmental and social impacts while maintaining investment viability for the Project. The Project design will undergo further refinement post-approval during detailed design, with a view to further minimise environmental and social impacts where possible within the approved Development Corridor, while maintaining investment viability of the Project.

2.5.2.1. Transmission Line Route Options

Two (2) options for the transmission line have been proposed, as shown in Figure 1-2, referred to as the northern and southern options. However, only one will progress during construction. Both options are similar in cost to construct and require crossings over Lake Burrendong. Therefore, the preferred option will be determined on the level of environmental constraints at the detailed design stage. Such constraints may include:

- Threatened Ecological Communities (TECs) and threatened species habitat.
- Identified Aboriginal items and places.

2.5.3. Do-Nothing Approach

As highlighted throughout this Section of the EIS, there has been significant progress made by Australia towards establishing guidelines and targets to reduce carbon emissions and promote renewable energy generation. Therefore, without this Project, other projects will need to be developed to meet the National RET for 2021 and NSW's target of net-zero emissions by 2050. Furthermore, the NSW Government could miss out on a significant investment into the Australian economy, with an expected capital investment value estimated to be greater than $30 million, that the Project is expected to deliver.

Under the 'Do-Nothing' scenario, the Project would not take place and the following benefits resulting from the Project would not occur:

- Generation of additional renewable energy
- Reduction of approximately 900,000 tonnes of $CO_{2\text{-}e}$
- Support of, on average, approximately 250 Full-Time Equivalent (FTE) jobs during the construction period and approximately 12 FTE jobs during the operational period.

CHAPTER 3

Project Description

3.1. Project Area

3.1.1. Location of the Project

The Project is located within both the Dubbo Regional Council LGA and Mid-Western Regional Council LGA in the NSW state electorate of Dubbo.

The Project Site is approximately 30 km south-east of Wellington (Figure 1-1). It is located across multiple land holdings, including 17 private landowners (containing 147 freehold lots) and 58 lots owned by the State of NSW. Further details on the Project location context are discussed in Section 2.2.

3.1.2. Land to be Disturbed

Technical assessments within the EIS are based on the preliminary Development Footprint design. This design includes all project elements and the potential construction footprint around them (both permanent and temporary disturbance areas). Therefore, the current footprint is indicative only and subject to change during the detailed design process post Development Consent. To allow for this project refinement to occur, a surrounding buffer area has been created to provide a Development Corridor in which the Development Footprint will be located. The Development Corridor (3,058.08 ha) is approximately 100 m either side of the Development Footprint (781.00 ha). The Project will seek approval to 'micro-site' the Development Footprint anywhere within the Development Corridor, with the assessments within the EIS having undertaken their assessment accordingly. The benefit of allowing micro-siting of Project elements within the Development Corridor will allow for greater flexibility in avoiding any potential impacts that may occur because of WTGs and their associated infrastructure.

Preliminary road upgrades have been designed, and the corridor assessed, from the Castlereagh Highway along the transport route (Section 6.6) providing a predicted disturbance area of 74 ha for external road upgrades.

Potential changes to the physical layout of the identified Project Elements are further discussed in Section 3.2.

3.1.3. Identified Constraints

Several environmental constraints have been identified within the Project Site (Figure 3-1). Effort has been made by the Proponent throughout the evolution of the Project layout to avoid identified environmental constraints where possible (Figure 2-15). Further discussion of Project design, including how the Proponent has implemented the design hierarchy of avoid, minimise, mitigate and offset is provided in Section 7.1.

- **Agricultural Land:** Land capability is characterised by underlying geological features, soil grouping, slope, and topography. The classification of land is based on biophysical features that determine the limitation and hazards of that land. Limitations to land capability include water and wind erosion, soil structure decline, soil acidification, salinity, waterlogging, shallow soils, rockiness, and mass movement. Land capability mapping shows the Project Site is predominately mapped as LSC Classes 5, 6 and 7, with smaller areas of LSC classes 3 and 4 (Figure 6-55). The high capability land (LSC Class 3) also corresponds to BSAL, of which 20.80 ha is located within the Development Corridor, associated with the proposed transmission line (northern option).

- **Major watercourses**: Several watercourses intersect the Project Site, ranging from 1^{st} – 9^{th} order watercourses (in accordance with the Strahler system). The proposed Development Corridor (access tracks) will be required to cross four (4) 3^{rd} order watercourses, four (4) 4^{th} order watercourses and one (1) 9^{th} order watercourse.
- **Native Vegetation and Threatened Species**: The Project Site borders Lake Burrendong and contains native vegetation and TECs within its boundary. Several threatened species have been identified within the Project Site (Section 6.5). Throughout the iterative design process, locations of native vegetation and threatened species have been avoided wherever possible, further reducing potential impacts.
- **Aboriginal Heritage:** No previously recorded Aboriginal sites were present within the Project Site. The Project Site can be characterised as a primarily stock grazing area with limited timber getting. The majority of the Project Site and surrounds contain steep terrain, and the WTGs are proposed on ridges and spur crests, which are typically rocky and highly exposed to the elements. However, 102 Aboriginal objects were identified during survey, of which six (6) were of moderate or high significance. The remaining sites were considered to have low significance (ELA, 2023c).
- **Nearby Landowners**: The Proponent has identified a total of 20 non-associated receivers within 4.95 km of a proposed WTG. The location of these receivers were used to form the basis of technical assessments such as the Landscape and Visual Impact Assessment in Section 6.3 (MLA, 2023; Appendix F) and Noise and Vibration Impact Assessment Section 6.4 (MDA, 2023; Appendix G).

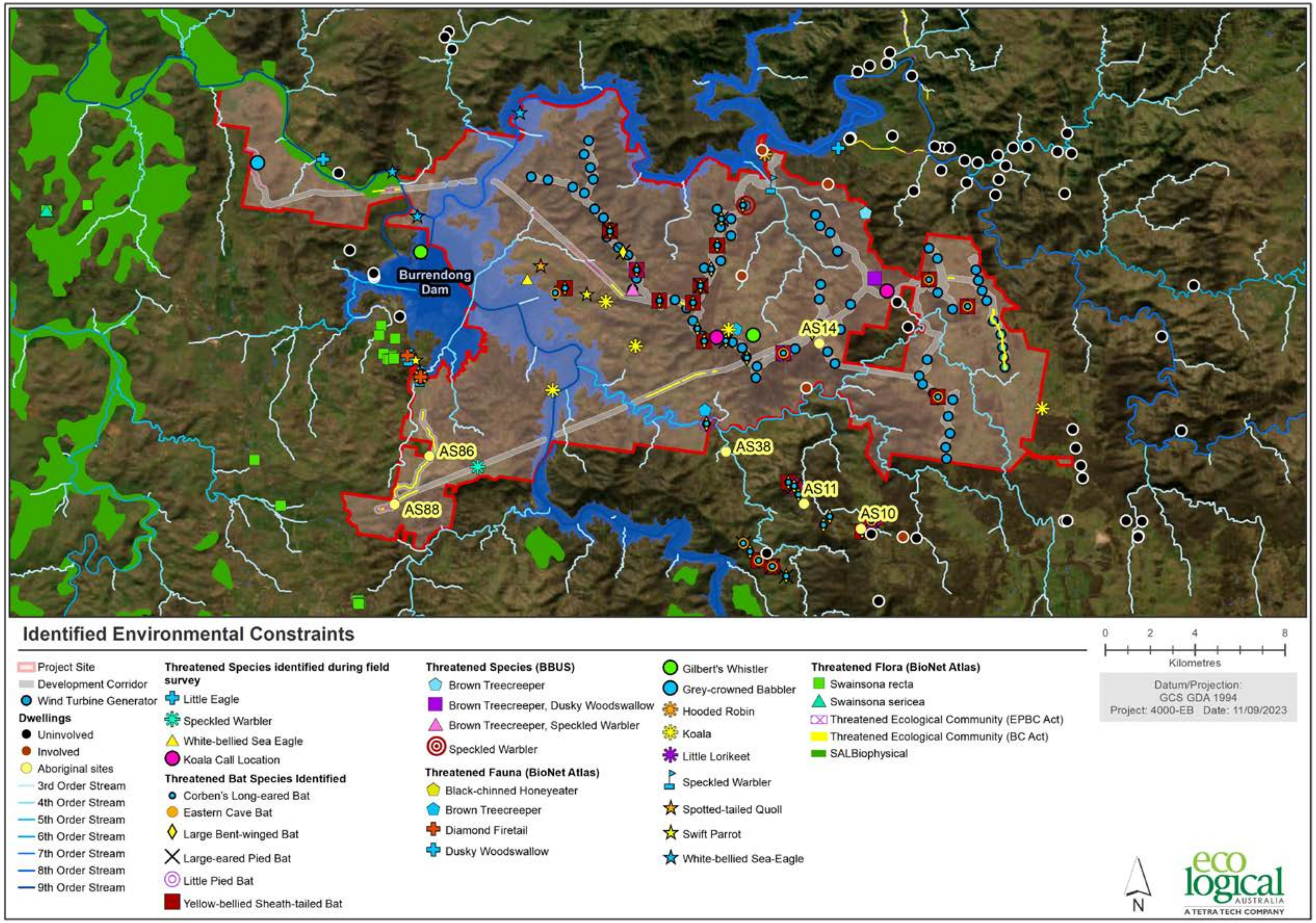


Figure 3-1: Identified constraints within the Project Site

3.2. Physical Layout and Design

3.2.1. Overview of Project Elements

Descriptions of each project element (Table 3-1) are provided in the sections below. The details of infrastructure and elements to be installed or construction (i.e., WTG model) will be confirmed during the detailed design process to be undertaken post consent and finalised prior to the commencement of construction. Detailed design will allow the most suitable types of infrastructure to be identified and deployed for use in the Project.

The dimensions in Table 3-1 represent the approximate dimensions proposed for project elements and infrastructure for the Project.

Table 3-1: Project Elements and approximate dimensions

Project Element	Details	Approximate Dimensions	Quantity
WTGs	WTG height	Up to 250 m	70
	Rotor diameter	Up to 180 m	
	Uppermost blade tip	250 m	
	Lowermost blade tip	70 m	
	Tower (hub) height	Up to 160 m	
	WTG foundations (excavation size)	35 m diameter	
Ancillary Infrastructure	Internal Roads and drainage	9 m x 79.04 km	N/A
	Substations	100 m x 200 m	Up to 2
	O&M Compounds	150 m x 70 m	1
	Medium voltage (33 kV) electrical connections, including: • Overhead transmission cables • Underground transmission cables	• 2.94 km overhead cables • 3 m x 56.61 km underground cables	N/A
	Permanent Meteorological Masts (concrete footings for mast and guy wires)	Ten footings of 1m^2 per mast	3
	Earthworks for Permanent Infrastructure (roads / hardstands) and for Temporary Facilities	Subject to detailed design	N/A
Temporary Facilities	Concrete (or asphalt) batching plants	200 m x 100 m	2
	Rock crushing facilities	TBC within Development Corridor	2
	Site compound and office	TBC within Development Corridor	1
	Stockpiles and materials storage compounds	Subject to construction requirements	N/A
	Temporary Field Laydown Areas	Subject to construction requirements	N/A
	Temporary Meteorological Masts (concrete footing for mast and guy wires)	Ten footings of 1 m^2 per mast	Up to 2

3.2.2. Wind Turbine Generators

The WTG market is continuously developing with a trend towards larger, higher capacity WTGs, which reduces the cost of energy. The Project has therefore been designed to accommodate a WTG of up to 250 m from the ground to upper blade tip.

The WTGs will be three-bladed, semi-variable speed, pitch-regulated machines with the rotor and nacelle mounted on a tower with an internal ladder or lift. Figure 3-2 below displays an illustration of a WTG, detailing the component parts.

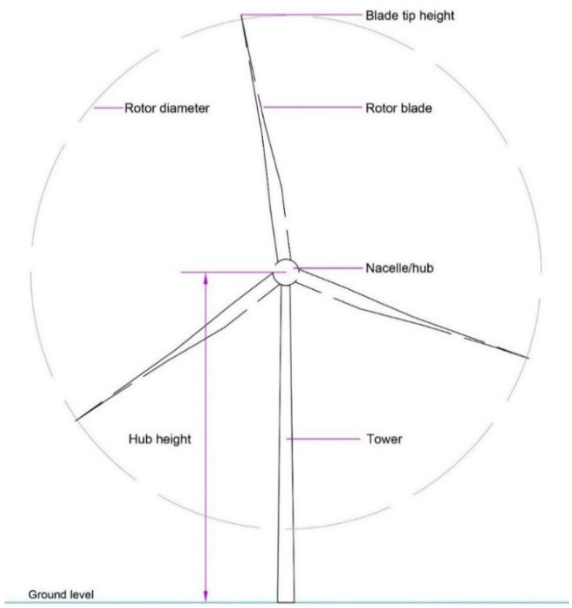


Figure 3-2: Components of a WTG

3.2.2.1. Foundations

The WTG tower would be mounted on a reinforced concrete foundation, requiring removal of rock and subsoil at its base. Numerous foundation design options are under consideration including a gravity foundation (where subsoil geology is less stable; Figure 3-3) and a rock-bolted foundation (where subsoil geology provides good bedrock). A combination of different foundation designs may be used on the site depending on the geology identified at each WTG location.

It will be necessary for detailed geotechnical surveys to be carried out pre-construction to determine the foundation type for each WTG. New WTGs are continually entering the market and it is possible that variations to these conventional foundation designs could occur prior to final WTG selection.

Figure 3-3: Example of gravity foundation

3.2.2.2. Towers

The supporting tower structure of a WTG is typically comprised of a reducing cylindrical tower made from either a welded steel shell, concrete, or a concrete steel hybrid, fitted with an internal lift and/or ladder. A range of tower heights have been considered for the Project with the final selection subject to competitive tender for WTG supply.

The tower is constructed in up to five sections, each section bolted or welded together via an internal flange (Figure 3-4). Within the core of the tower are the power and control cables and an access ladder or mechanical person lift to the nacelle (with safety climb system). Towers will typically be manufactured and transported to the Project Site in up to five sections for on-site assembly. For the purposes of this EIS, the centre of the hub height is considered equal to the tower height. Atop the tower sits the nacelle to which the hub is mounted, and the three blades are attached to the hub.

Figure 3-4: Example of WTG tower section

3.2.2.3. Nacelle

The nacelle of a WTG sits at the top of the tower and houses the generator, gearbox (unless using a direct drive) and control gear including motors, pumps, brakes and electrical components. The nacelle control gear ensures that the wind turbine always faces into the wind and adjusts blade angles to maximise power output and minimise blade noise. The nacelle also houses winches to assist in lifting maintenance equipment or smaller replacement parts to the nacelle.

The nacelle design considers acoustic factors to minimise noise emissions from mechanical components.

3.2.2.4. Rotor

The WTG rotor drives the generator within the nacelle producing electrical output. In general, a larger rotor enables greater generation capacity, however site-specific wind conditions influence the rotor selected for installation at any given wind farm.

The Project is designed to include rotors of approximately 180 m. However, it is possible that larger rotors will be required depending on the specifications of blades on the market at the time of construction. If so, the selected WTGs would remain within the 250 m tip height envelope and overall swept area for the Project would not exceed the limit assessed within this EIS, which would be achieved with the installation of fewer WTGs.

3.2.2.5. Blade

WTG 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 (Figure 3-5).

Single piece blade lengths of 107 m are currently in production (the off-shore GE Haliade-X). Longer blades can be expected as WTG technology develops further and with consideration of the introduction of multi-piece blade construction. Multi-piece blades will greatly improve transport logistics and reduce traffic and transport impacts. Whether the Project installs single or multi-piece blades is dependent on detailed design and the Project's engineering and procurement processes after the Project would receive Development Consent. To allow for the advancements in available blade lengths, this EIS has considered a single blade up to 110 m and hub section of approximately 7 m, that makes a rotor 180 m in diameter.

Uppermost blade tip comprises the highest point of the WTG when in a vertical position. Recent advances in WTG technology have meant that WTGs with blade tip heights of 200 m are currently operating in NSW with larger WTGs of 250 m expected to be available for the market in the coming years. Lowermost blade tip refers to the height between the ground and the lowest point of rotor when in operation.

Figure 3-5: Example of WTG blades

3.2.2.6. Generator Transformer

WTGs produce electricity at a low voltage which is then stepped up to medium voltage. Each WTG would produce power at typically 690 V, and up to 1,000 V. Power is then transformed at each WTG to either 22 kV or 33 kV for reticulation around the Project Site. The transformer for each WTG would be located either within the base of the tower, in the nacelle, or externally adjacent to the tower as a small pad-mount transformer installed on the ground, depending on the specific WTG model selected. The transformer would be either a dry-type transformer or oil-filled and would be suitably bunded.

3.2.3. Ancillary Infrastructure

Ancillary infrastructure refers to all wind farm infrastructure except for the WTGs, and includes substations, O&M compounds (including offices and car park), electrical infrastructure (including underground and overhead electricity transmission lines), 3 permanent meteorological masts, hardstands, and internal roads.

3.2.3.1. Substations

Substations include the infrastructure required to collect the internal electrical reticulation and increase the voltage for transmission to connect to the grid, and the infrastructure to physically connect to the grid (switching station). Up to 2 new Collector Substations will be located within the Project Site. The Collection Substations will collect power generated by the WTGs and deliver it to the new overhead powerline.

Each Collection Substation will include all necessary ancillary equipment such as lengths of connecting powerlines, control room and cubicles, communication equipment and amenities. The connection substation also requires telecommunications (cable, optic fibre and/or microwave links) and backup electricity connections (415 V – 11,000 V) from local services, and an appropriate access road. Each

Collection Substation area would be surrounded by a security fence as a safety precaution to prevent trespassers and stock ingress. The ground would be covered partly by crushed rock and partly by concrete pads for equipment, walkways, and cable covers. There would also be an earth grid extending outside of the boundary of the security fence.

Each Collection Substation will include up to two large power transformers to change the voltage from the reticulation voltage (expected 22 kV or 33 kV) up to the powerline voltage. Additionally, the substations will include an appropriate bushfire Asset Protection Zone (APZ) that complies with the RFS Planning for Bushfire Protection 2019 guidelines. This has been evaluated based on the vegetation type and slope.

Typically, each collector substation would take up an area up to 100 m x 200 m. The proposed locations for each collector substation have been identified and are shown on (Figure 1-2).

3.2.3.2. Operations and Maintenance

An O&M compound will be established for the day-to-day operation of the Project and would take up an area of approximately 150 m x 70 m or at the indicative location shown in (Figure 1-2). The O&M compound may include a lay down area, site operations facilities and a services building, workshop, storage, parking, and other facilities for operations staff. The building of the operation compound will house office space, toilet, kitchen, communications equipment, meeting room and routine maintenance stores.

3.2.3.3. Transmission Lines

A series of underground and overground transmission lines are proposed to conduct electricity generated by the WTGs and would connect to the existing TransGrid transmission line on the western side of Lake Burrendong. The preliminary electrical layout includes both underground and overhead reticulation connecting the WTGs and Substations to the existing transmission network. The internal electrical network will likely comprise 33 kV circuits between the WTGs and Substations, and a 132 kV or 330 kV transmission line between the other substations. Underground transmission lines and control cables will be installed below the ground surface to conduct electricity between the WTGs and Substations. Voltages ranging from 33 kV to 330 kV may be constructed in single or double-circuit configurations depending on the WTG selected for the Project and any staging considerations.

Sections of the proposed overhead transmission lines may need to be placed underground subject to local conditions and conversely sections of the proposed underground transmission lines may need to be placed overhead subject to local conditions. They will be located during the period following engineering, procurement, and construction (EPC) contract tendering and award when detailed design is undertaken.

Overhead Transmission Cables

Overhead transmission lines can reach up to 50 m in height, with insulators and a typical span length as shown in Table 3-2. The Project is working closely with landowners to ensure impacts of overhead transmission lines are mitigated wherever possible. The required easement or leased width for a transmission line may vary due to terrain and alignment, such as to accommodate sharp changes in direction.

Table 3-2: Indicative transmission line specification

Voltage	Approximate Easement Width	Approximate Height of Pole	Typical Span Distance (Pole to Pole)
330 kV	60 m	35-50 m	200 – 300 m
132 kV	45 m	35-50 m	200 – 300 m
66 kV	30 m	30 m	150 – 250 m
33 kV	30 m	20 m	150 m

Underground Transmission Cables

During WTG and Electrical Compound base construction, underground transmission lines would be installed. Underground transmission cables (including control cables and earthing (refer section below)) crossing watercourses will be designed and constructed considering:

- Managing Urban Stormwater: Soils and Construction (Landcom, 2004) manual, or its latest version
- Controlled activities on waterfront land – Guidelines for watercourse crossings on waterfront land (DPI Water, 2012);
- Controlled Activities: Guidelines for laying pipes and cables in watercourses on waterfront land (DPI Water, 2012).

The general procedure for laying of underground transmission lines will be as follows:

- Preparation work, including installation of gates / temporary removal of fences, as required.
- Use of an excavator or rock saw to dig a trench.
- Material excavated is stored adjacent to the trench for subsequent backfilling.
- Laying of bundled cables within a bed of protective sand.
- Placement of tape warning of the presence of electrical cables at the required depth.
- Backfilling and compaction of previously excavated material in layers by use of a vibration plate compactor, all in accordance with engineering specifications.

All trenches would be marked with warning tape and backfilled once the cables were in-situ. On completion the underground transmission lines may be marked with small marker posts and the surrounding vegetation will be allowed to regrow.

Several creek crossings may also be required to support the required machinery and construction of cables. Crossings not required for future maintenance activities will be decommissioned following the completion of construction works. Those that are required for ongoing use during operations will be designed and constructed in accordance with the relevant guidelines listed above.

During construction, Temporary Field Laydown Areas will be positioned along the proposed transmission line route to store equipment such as transmission poles and conductors. No fuel, oil or chemicals will be stored at these locations.

3.2.3.4. Control Cables and Earthing

Computerised controls within and between the WTGs, Substations, and the O&M compound(s) automatically control the Project. Recording systems will monitor wind conditions and energy output at each of the WTGs and Battery Storage.

Remote 24-hour monitoring and control of the Project will also occur. Control cables will consist of optic fibre, twisted pair or multi-core cable and will be located underground within the clusters of WTGs or attached to the overhead transmission lines. No additional impact will occur as the cabling will be paired with the transmission lines either above or below ground. The installation of buried earthing conductors and electrodes will also be required in the vicinity of the WTGs, Substations, and the O&M compound(s).

3.2.3.5. Permanent Meteorological Masts

The Proponent operates a temporary wind monitoring mast and several remote sensing SoDARs on the Project Site to assess wind speeds at or near proposed WTG locations. Following construction of the Project, 3 permanent wind monitoring masts would be required to assist with the control and operation of the Project. These would be static guyed masts with remotely operated wind monitoring equipment installed at multiple heights on each mast. Each mast could require hub-height wind monitoring; therefore, masts are expected to be around 150 m tall.

Pending final WTG placements, it may be necessary to move or install additional permanent wind monitoring masts to verify wind speeds across the Project site. The temporary and permanent masts would be located within the Project site boundary. The Proponent will inform Civil Aviation Safety Authority (CASA) and the Department of Defence (DoD) of the location of any monitoring masts constructed.

3.2.3.6. Telecommunications Facilities

Telecommunication facilities providing for transmission of voice, data, image, graphic and video information are proposed to be installed on site at standalone locations or onto wind farm infrastructure such as permanent masts.

The telecommunications facilities including (if required) masts and the guy wires that secure them may need to be located outside of the Development Corridor, however they will remain within the Project Site.

The final number and location of the Telecommunications Facilities will be determined post-Development Consent, post-WTG selection and detailed design in discussion with the relevant telecommunications service provider.

3.2.3.7. Hardstands

Hardstands are required adjacent to each WTG location for the assembly, erection, maintenance, repowering and/or decommissioning of a WTG. Indicative hardstand dimensions are 80 m x 40 m, however, this is likely to vary dependent on detailed design, topography, and construction methods.

Hardstands will be surfaced with pavement material to required load-bearing specifications, maintained throughout the construction and operational life of the Project, and used principally for construction and periodic maintenance of the Project. Surrounding the hardstand is an area of disturbance included in the Development Footprint which is not a hardstand area but will be used for WTG component laydown and crane structure assembly (among other WTG erection and construction related activities) as well as cut and fill.

3.2.3.8. Internal Roads

Internal access tracks, turning heads and hardstands will be established within the Project Site for the construction, operation, repowering and/or decommissioning of the Project, from the public road access locations, WTGs, Substations, and other permanent and temporary facilities. This will be done using heavy earthworks machinery (generally early in the construction program) to excavate roads and hardstand areas to appropriate depths. Material excavated on-site for WTG and compound foundations and internal road alignments will be crushed on-site and used for road base or aggregate subject to meeting the relevant functional specifications.

Each WTG would require an access track and electrical cabling to the collection substations. Where possible, the access tracks will follow existing farm tracks, would have a trafficable width of 5.5 m (wider at bends and passing lanes) and be all weather graded gravel tracks. Hardstand areas are required beneath each WTG for delivery, storage, and assembly of WTG components, and for the safe operation of WTG installation cranes. Each hardstand area would be approximately 80 m x 40 m. The shape and exact size of the hardstand area is subject to final turbine selection and crane lifting requirements.

Access tracks and hardstands areas would generally be left in situ after construction to allow for any required maintenance and repairs.

All access tracks upgrades to accommodate the construction traffic loads, as well as for maintenance purposes during operation. Access to the Project Site will be restricted from public access. The internal track network is approximately 79 km in length and is shown in Figure 1-2. Small culverts may also be required to be constructed where internal access roads cross streams.

Detailed design and construction requirements of the road crossings of waterways (where required) will be undertaken post-Development Consent in consideration of:

- Managing Urban Stormwater: Soils and Construction (Landcom 2004) manual, or its latest version
- Policy and Guidelines for Fish Friendly Waterway Crossings (NSW DPI 2004)
- Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge 2003).

3.2.3.9. Utility Services

The Project will be connected to TransGrid's transmission network and when not generating will draw a minor amount of electricity from the grid. Backup and emergency power at the Substations may be supplied by a local distribution line, on-site batteries and/or a standalone diesel generator. Two separate and independent telephone communications facilities (optic fibre and microwave) will be required to be installed between the Substations as required by the AEMO to enable safe remote monitoring and control of the Project. Mobile telephone coverage is available on some of the ridgelines and plateaus with limited or no service available on most of the valley floor. Although the Project will not rely on this form of communication, it can be assumed that members of the construction, O&M teams will communicate using both mobile telephones and radios.

Operational water requirements will be provided to the proposed facilities and auxiliary services building from a storage tank designed to collect water from roof drainage and augmented by potable water delivered by tankers. An approved septic system or composting system will be installed to treat minor quantities of wastewater, subject to securing the relevant authorisation. Other waste will be classified and removed from the Project Site to an approved facility (landfill, recycling etc).

3.2.3.10. Signage

Traffic signage required as part of traffic safety during construction will be installed by the contractor, in compliance with relevant regulations and in accordance with any permits obtained for traffic management.

Signage will be erected at critical locations from the outset of construction, directing all vehicles associated with the construction site to the Project Site office. Additional signage would be located close to the Project Site, providing information about the Project, the companies involved and essential safety information and telephone numbers.

Consultation with relevant local Councils and Transport for NSW (TfNSW) will be initiated to determine final signage locations.

3.2.4. Temporary Facilities

Temporary Facilities will consist of site offices and compounds, rock crushing facilities, concrete or asphalt batching plants, stockpiles and materials storage compounds, temporary field laydown areas, minor 'work front' construction access roads and temporary meteorological masts. The location of Temporary Facilities is described in the following subsections.

All temporary facility sites will be rehabilitated once they are no longer required in accordance with detailed measures to be defined within the Project Biodiversity Management Plan (BMP).

3.2.4.1. Site Offices and Compounds

During the construction phase up to 250 staff would be working on site at any time. Suitable locations for one site office would be selected, avoiding areas that are regarded as having environmental constraints. The site offices may include several demountable buildings and amenities blocks located on site for the duration of construction. Sufficient parking would be provided for the expected usage.

3.2.4.2. Rock Crushing and Concrete or Asphalt Batching Plants

Temporary rock crushing and up to two (2) portable concrete or asphalt batching plants are proposed to process aggregate and concrete for the WTG foundations, electrical infrastructure, and Internal Roads, as well as asphalt if required for Internal Roads. Following detailed geotechnical site investigations and the final Project layout, accurate estimates of material requirements will be confirmed. If the extraction and processing thresholds exceed Schedule 1 of the *Protection of the Environment Operations Act 1997* (POEO Act), an Environmental Protection Licence (EPL) will be obtained from the Environment Protection Authority (EPA) for the operation of rock crushing or concrete batching facilities.

The concrete batching plants would collectively produce up to 600 m^3 of concrete per day when a WTG foundation is being poured. The operational period of the concrete batching plant would be for the life of the construction phase and the plant would produce a maximum of 590 tonnes per day. The batch plant operations would therefore require a license to be issued by NSW Environment Protection Authority (EPA) (under the POEO Act), given the amount exceeds the license threshold of 150 tonnes per day.

A typical on-site concrete batching facility would occupy an area of approximately 100 m x 100 m and likely consist of a concrete mixer, cement bins, sand and aggregate stockpiles and storage facilities for various equipment and tools. Similarly, an on-site asphalt batching plant facility would occupy an area of approximately 50 m by 100 m and likely consist of a plug-mill mixing chamber, aggregate dryer, bitumen tanks, aggregate bins and a storage container for various equipment and tools. A rock crusher would occupy an area of approximately 50 m by 100 m and consist of a tracked mobile crushing unit, conveyor belts, feeder, and engine. Each facility is sized for the use of front-end loaders, delivery of materials and entry and exit of vehicles and have sufficient storage are for materials for five days batching. The batching plant would include an in-groundwater recycling / first flush pit to prevent dirty water escaping onto the surrounding area and would be fully remediated after the construction phase.

Suitable locations for such facilities are not identified as they will be dependent on detailed design and construction programming. Their locations will be selected in accordance with the Development Consent, considering noise, amenity, biodiversity, traffic management and heritage. Specific operational requirements have been identified in the relevant environmental assessment and will be managed via the appropriate management plan. Some temporary rock crushing may occur throughout the Project Site using mobile plant if required following excavation of rock material to reuse in the immediate area and maximise construction efficiency.

3.2.4.3. Laydown Areas and Construction Compounds

Temporary lay down areas to store materials and carry out pre-assembly works will be located at the construction compounds and at selected locations across the Project Site, where required. These areas would be typically fenced off and secured but may also include the use of paddocks for a short term where required across the site.

Temporary construction compounds will be erected and maintained during the construction phase, which will generally include amenities, offices, staff facilities, stores, car parks, communication equipment, visitor facilities and safety areas.

3.2.4.4. Temporary Meteorological Masts

There is currently one temporary 110 m tall meteorological mast installed within the Project Site. It is expected that one additional temporary meteorological mast will be installed within the Project Site prior to the start of construction of the Project.

Temporary Meteorological Masts will require a low voltage cable connection for power and a communications cable to be laid. The trench required for this will be approximately 1 m in width and would come directly from the closest WTG.

3.2.5. Site Access

The Project Site will be accessed from the public road network during construction and operation. The access points will have gates and be secured, and appropriate warning signs erected.

The main site entry will be via Burrendong Dam Road. This will be the main access point for over-size, over-mass (OSOM) vehicles as well as heavy and light vehicles.

As the nearest seaport to the Project Site is the Port of Newcastle, it is the most likely port of entry for shipped Project components, so assessment was undertaken of the vehicle transport from that port. However, the port of entry will not be known until post-Development Consent tender, contractor selection, optimisation, detailed design, and procurement process is complete, and as such an alternative port may need to be used. Access routes and points for Project transport have been discussed and assessed in the relevant impact assessment sections (Biodiversity – Section 6.5 and Traffic and Transport – Section 6.6). The route from the Port of Newcastle for OSOM vehicle transport would be via:

- Selwyn Street
- George Street
- Industrial Drive
- Maitland Road
- New England Highway
- Golden Highway
- Castlereagh Highway
- Goolma Road
- Twelve Mile Road
- Yarrabin Road
- Burrendong Dam Road
- Endacott Road.

This route will require numerous road upgrades, including:

- Twelve Mile Road and Goolma Road Intersection: Upgrading and widening
- Twelve Mile Road: Local widening of bends, upgrading of waterway crossings, replacement of cattle grids and potential upgrading of overheard line crossings
- Yarrabin Road: Local widening of bends, upgrading of waterway crossings and flood ways, replacement of cattle grids, vegetation removal and potential upgrading of overhead line crossings
- Yarrabin Road and Burrendong Dam Road intersection: Upgrading and widening
- Burrendong Dam Road: Widening of bends, upgrading of waterway crossing and tree trimming
- Endacott Road: Realignment and widening of bends and vegetation removal.

OSOM, Heavy and Light Vehicle routes will be further defined during the post-Development Consent period in the preparation of the Traffic Management Plan (TMP) and in consultation with TfNSW, DRC and MWRC.

It is noted that the Uungula Wind Farm is required to undertake road upgrades as part of the Conditions of Consent (SSD-6687). Some upgrades, as outlined in Table 3-3 may be able to be used for the Project.

Table 3-3: Required road upgrades for Uungula Wind Farm relevant to the Project

Road / Intersection	Start Point	Chainage	Upgrade
Twelve Mile Road Intersection	Goolma Road	00 km	• Permanently remove and close the existing intersection; and • Design and construct a new intersection with a channelised right turn lane and an Auxiliary Left turn lane treatment.
Twelve Mile Road	Goolma Road	00 km to 13.76 km	• Reconstruct the pavement full length to the horizontal and vertical alignment in compliance with TfNSW's Roadworks specifications – design and construct (TfNSW 2021) or its latest version.

3.2.6. Mitigation Measures in Physical Layout

As part of the development of the physical layout and design of the Project, mitigation measures were designed to be integrated into the Project. These measures are designed to stop, limit, or mitigate some of the risks associated with the development of the Project and include, but are not limited to:

- Prevention measures associated with fire hazard risk for the proposed transformers and equipment, and WTGs, as detailed in Table 6-60.
- Prevention measures associated with public health and magnetic fields, including increasing the distance from the source, rearranging equipment layout and equipment orientation and substation sitting, as detailed in Table 6-60.
- Prevention measures associated with bushfire and electrical fire, including the construction and maintenance of APZs, lightening protection, heat barriers, heat and/or smoke detection systems, and suppression systems.
- Prevention measures associated with blade throw, including ensuring the WTG components are manufactured and certified to current best practice Australian and international (IEC 61400-23) safety standards.
- Prevention measures associated with visual amenity, including ensuring uniformity in the colour, design, rotational speed, heigh and rotor diameter of the WTGs, the use of simple muted colours and non-reflective materials to reduce distant visibility and vegetation screening, as detailed in Table 6-10.

3.2.7. Components of the Physical Layout that May Change

The Project seeks flexibility to refine the final layout and details of infrastructure and elements to be installed or constructed (i.e., WTG model, battery storage technology), subject to the post-Development Consent, tender, contractor selection, optimisation, detailed design, and procurement process. Flexibility will allow the most suitable types of infrastructure to be chosen and the layout optimised for the Project generally in accordance with this EIS and within the limits of the Development Consent. All assessments within this EIS have considered the largest predicted project components (such as WTG blades etc) and assessed an overall envelope for the creation of the Development Corridor.

The Project described in this EIS is indicative only and subject to a detailed design process. The proposed layout has been prepared based on the best knowledge available at the time and by applying the avoidance hierarchy approach.

Although 70 WTGs are proposed, commercial considerations and technological advancements may lead to fewer than 70 WTGs to be constructed and operated, at the discretion of the Proponent. All 70 WTG locations have been included in this EIS to assess worst-case impacts and to allow the flexibility to determine the optimal project layout within the limits of the Development Consent, generally in accordance with this EIS, post-Development Consent. The proposed Project layout presented in this EIS is a product of the Proponent's commitment to avoid environmental and social impacts and mitigate any remaining impacts to the maximum extent possible.

If Development Consent is granted, preferred suppliers will be selected following a tender and contractor selection process. Any potential supplier will have unique requirements and specifications such as transport vehicle turning radii, access and exit gradients and crane requirements. The final design will only be known following selection of Project components and the completion of the detailed design by the construction contractor post-Development Consent. The ability to micro-site the WTGs, Ancillary Infrastructure and Temporary Facilities within the Development Corridor post-Development Consent is required to enable optimisation of the Project and minimisation of impacts.

The locations of some Project elements are not known at this stage and will be subject to the detailed design and construction phase programming. These are described in the relevant section and include (but are not limited to) the Meteorological Masts (both Temporary and Permanent and including the location of their power supply cables) and the Temporary Field Laydown Areas. Those will be located within the Project Site with impact minimisation guiding their placement.

3.3. Uses and Activities

3.3.1. Land Uses

The Project site is zoned as RU1 (Primary Production) and E3 (Environmental Management), with a minor SP2 (Infrastructure) zoning to the north which corresponds with a tourist park (Figure 4-3). The Project is located within both the Dubbo Regional Council (the result of a merger between Wellington and Dubbo Shire Councils) and Mid-West Regional Council (Figure 1-1).

The ownership of the land is comprised of 17 private landowners (containing 147 freehold lots) and 57 lots owned by the State of NSW, including 46 lots owned by WaterNSW. The Project Site borders Lake Burrendong to the West of the site. The majority of the Project Site has been previously degraded or modified for agricultural development and consists of a mix cleared lands and remnant woodlands and forests. Some sections of the Project Site however do contain areas of intact native vegetation which partially influenced the design process of the Project to avoid areas of native vegetation where possible.

The Project Site is located within the Far West and Orana region of NSW, which has an assumed area of approximately 33,936,588 ha. Of the total area of the Far West and Orana region, agricultural practices such as grazing native vegetation, modified pastures, cropping, and horticulture utilise approximately 29,620,376 ha, or 87.28%, (ABARES, 2023). The Project will involve the temporary diversification in land use of up to 3,058.08 ha (Development Corridor), accounting for 0.01% of all land used for agriculture in the Far West and Orana region, for the duration of the Project life. While this temporary change in land use may reduce agricultural production, the reduction will primarily be a result of the construction period. Following the completion of construction works, grazing will continue within the Project Site, allowing for the continuation of agricultural activities and helping to control vegetation. Therefore, at a regional level, impacts to agricultural production will be minimal. At the conclusion of the life of the

Project, the Project Site would be decommissioned and rehabilitated to permit the resumption of grazing activities across nearly all the previously utilised area.

3.3.2. Proposed Activities within the Project Site

The proposed activities for each Project phase are outlined in Table 3-4

Table 3-4: Proposed activities during Project stages

Project Phase	Proposed Activities
Pre-Construction Works	Surveys including building/road dilapidation surveys
	Minor clearing or translocation of native vegetation.
	Installation of temporary site offices and compounds.
	Installation of environmental impact mitigation measures, fencing, enabling works, meteorological masts.
	Flora and fauna investigations and pre-clearing surveys, inspections.
	Intersection and road upgrades on the public road network as outlined in Section 6.6.
	Establishment of Project Site access points, minor access roads and minor adjustments, etc. including associated vegetation removal and heritage artefact salvage.
Construction Works	Includes all physical works to enable the operation of the Project, including but not limited to, the construction and installation of WTGs, compounds, transmission lines, construction of ancillary infrastructure and the establishment or construction of any temporary facilities which were not already established during the pre-Construction minor works phase.
Operation and Maintenance	Ongoing operation, monitoring (both on-site and remote monitoring) and maintenance of all Project infrastructure and land within the development corridor during the operational lifespan of the Project (approximately 30 years).
	Maintenance of land within Development Corridor.
	Replacement of major components as required, such as WTG blades. This may require the use of cranes and ancillary equipment.
Decommissioning	Includes all physical works required for the dismantling and transportation of Project infrastructure and restoration of the Project Site to near prior condition.

3.3.3. Transport of Materials and People

The Project Site will be accessed from the public road network as described in Section 3.2.5.

As the nearest seaport to the Project Site is the Port of Newcastle, it is the most likely port of entry for shipped Project components, so assessment was undertaken of the vehicle transport from that port. However, the port of entry will not be known until post-Development Consent tender, contractor selection, optimisation, detailed design, and procurement process is complete, and as such an alternative port may need to be used. Over Size, Over Mass (OSOM) vehicle transport to the Project Site from the Port of Newcastle has been assessed in a route study contained in Section 7.5. The route from the Port of Newcastle for OSOM vehicle transport would be via:

- Selwyn Street
- George Street
- Industrial Drive
- Maitland Road

- New England Highway
- Golden Highway
- Castlereagh Highway
- Goolma Road
- Twelve Mile Road
- Yarrabin Road
- Burrendong Dam Road
- Endacott Road.

This route will require numerous road upgrades, including:

- Twelve Mile Road and Goolma Road Intersection: Upgrading and widening.
- Twelve Mile Road: Local widening of bends, upgrading of waterway crossings, replacement of cattle grids and potential upgrading of overheard line crossings.
- Yarrabin Road: Local widening of bends, upgrading of waterway crossings and flood ways, replacement of cattle grids, vegetation removal and potential upgrading of overhead line crossings.
- Yarrabin Road and Burrendong Dam Road intersection: Upgrading and widening.
- Burrendong Dam Road: Widening of bends, upgrading of waterway crossing and tree trimming.
- Endacott Road: Realignment and widening of bends and vegetation removal.

Over-Sized, Over Mass (OSOM), Heavy and Light Vehicle routes will be further defined during the post-Development Consent period in the preparation of the Traffic Management Plan (TMP) and in consultation with Transport for NSW (TfNSW), DRC and MWRC.

It is noted that the Uungula Wind Farm is required to undertake road upgrades as part of the Conditions of Consent (SSD-6687).

3.3.3.1. OSOM Vehicle Transport Route from Port of Entry and Required Upgrades

The delivery of WTG components utilising OSOM vehicles will only occur during months 15-21 of the construction phase. The OSOM transport route to the Project has been assessed from the Port of Newcastle and was assessed in the External Route Study by iCubed (2020) in Appendix I. OSOM deliveries are therefore likely to be grouped together on particular nights to reduce impacts on the road network and to avoid peak hours and local traffic during the day. This will be subject to approval by TfNSW.

3.3.3.2. Transport of Employees

Given the rural nature of the Project and limited accommodation options available in close proximity, employees will be required to transit to the Project Site, likely from a number of townships in the area. The majority of the construction phase is anticipated to have an average workforce of 250 employees, with a peak of 375 expected. It is assumed that the average carpooling rate amongst employees is approximately two (2) employees per light vehicle, with a small number of minibuses likely to be used as well. This will result in approximately 125 vehicles accessing the Project Site each day and would make up an estimated 81-83% of total Project related traffic.

Based on location, population and availability of resources, general light vehicle traffic generated by employees and heavy vehicle deliveries are assumed to originate from the locations listed in Table 3-5.

Table 3-5: Origin/Destination of local employees (Stantec 2023)

LGA	Township	Travel Route	% of Local Staff	Approx. Travel Time
Mid-Western	Mudgee	Eastern Route (Route 1)	60%	40 min
Dubbo	Wellington	Western Route (Route 2)	20%	90 min
Dubbo	Dubbo	Western Route (Route 2)	20%	110 min

3.3.4. Resource Requirements

3.3.4.1. Cement, Aggregate, Sand and Asphalt

Due to the presence of vast mining interests in the region, the sourcing of gravel and other raw material is found to be widely and readily available. Cement for the foundations will be sourced following the civil construction company selection and may occur locally or from an alternative supplier. Additionally, aggregate and sand will be sourced as close to the Project Site as possible. The use of rock crushers on site will help facilitate recycled materials to be used on site.

3.3.4.2. Water

The water requirements for the Project will be met in accordance with the provisions of the *Water Management Act 2000* (WM Act) by sourcing water from within the locality where practicable and from a licensed supplier. For the fixed water requirements for the Project, a total of 972.5 ML is estimated to be required for the earthworks (956 ML), the WTG footings (10.5 ML) and transmission line footings (6 ML). In addition to this is the amount of water required for dust suppression, the amount of which varies based on the length of road being actively used and the climate at the time (further discussed in Section 6.11).

The amount of water required for this Project will need to be sourced from an appropriate location with the relevant licences. Sources of water nearby are the Macquarie River, Cudgegong River, Burrendong Dam, and catchment farm dams (used for stock).

3.3.4.3. Road Base

Road base material will be required for the construction of internal roads to access the WTGs, substations, compounds, and other ancillary infrastructure within the Project Site. Where practicable, part of the road base requirement will be sourced from material extracted from WTG foundations and any cut and fill from road construction, utilising rock crushing plant. Where the remainder of material is required, it will be sourced and imported to site via a suitably approved quarry.

3.4. Timing

Following the issuance of Development Consent, should consent be granted, it is anticipated that construction works will begin within one (1) to five (5) years. This is a culmination of factors that will determine the commencement of works, including the selection of civil contractors, the need for any additional permits and authorisations, post-Development Consent, optimization, detailed design, and procurement processes. The staging of the Project is also a consideration, as discussed below. An indicative timeline is provided in Table 3-6.

Table 3-6: Anticipated Project timeline

Phase	Approximate Duration
Pre-Construction (tender, detailed design, contract development)	12-18 months
Construction	18-24 months
Operation	30 years
Maintenance	Continuous and Ongoing
Decommissioning	At completion of Project Life

3.4.1. Staging

It is intended that the Project may be constructed, operated, upgraded and/or decommissioned in stages of various sized or permutations within the parameters of the Development Consent. Staging would be determined post-Development Consent tender, contractor selection, optimisation, detailed design, and procurement processes.

3.4.2. Project Phasing

This section provides a description of the various phases of the Project lifecycle which would commence pending Development Consent.

The Project as described in this EIS is indicative and subject to changes following the detailed design process. The proposed layout of the Project has been prepared based on a range of factors and the best knowledge available at the time. The development of wind energy technology is progressing at a rapid rate. Therefore, while the Project proposes to develop 70 WTGs, commercial considerations, and technological advancements at the time of development may lead to fewer WTGs being selected for construction and operation.

Further design variations relate to specific requirements of the preferred suppliers selected following the granting of development consent. If granted, the preferred suppliers will have unique operating requirements and specifications, such as transport vehicle turning radii or crane requirements that would need to be considered as part of the final design process.

3.4.2.1. Micro-Siting Criteria

The Project layout as assessed in this EIS includes a Development Corridor surrounding the proposed Development Footprint. The Development Corridor provides a 100 m buffer within the Development Footprint within which Project infrastructure may be to avoid specific environmental constraints. WTGs, ancillary infrastructure, and temporary facilities will be micro-sited during the optimisation, detailed design, and construction phases. The final micro-siting of project elements will not occur until the construction period and will be undertaken to meet the following criteria:

- On-ground impacts are to remain within the Development Corridor shown in Figure 1-2.
- No WTG is moved more than 100 m from the relevant Geographical Positioning System (GPS) coordinates shown in Appendix B.
- The micro-sited location of the WTG, ancillary infrastructure or temporary facilities would not result in any non-compliance with the Development Consent once granted.

3.4.2.2. Pre-Construction

Post Approval

Once all required approvals have been obtained, secondary approvals will be acted upon including approval of the Environmental Management System (EMS) and associated management plans, and application for an Environment Protection Licence (EPL) (if required) and other relevant authorisations.

Minor Works

Prior to the commencement of construction, minor works will take place to further inform the detailed design and prepare the Project Site for construction. This may include:

- surveys
- implementation of environmental safeguards such as sediment fencing
- minor clearing of native vegetation
- establishment of temporary facilities.

3.4.2.3. Construction Works

Construction works will commence following provision of detailed design inputs, which may be staged. Construction includes all physical works to enable the operation, including, but not limited to, the construction and installation of WTGs, construction of ancillary infrastructure and establishment or construction of any Temporary Facilities which were not already established as part of the minor works.

ROAD UPGRADES

Except for the OSOM vehicle transport route, the road upgrades will be undertaken prior to the commencement of construction to the satisfaction of the relevant roads' authorities. The External Road Upgrades for the OSOM vehicle transport route from port of entry to the Project Site will be undertaken prior to OSOM vehicle transport.

TEMPORARY FACILITIES

Construction of temporary facilities such as offices, parking bays and toilet facilities will be undertaken. Temporary concrete or asphalt batching plant and rock crusher facilities will also be established.

ANCILLARY INFRASTRUCTURE

Internal Roads

Internal roads, turning heads and hardstands will be established using heavy earthworks machinery. Material excavated on-site for WTG and compound foundations and internal road alignments will be crushed on-site and used for road base or aggregate subject to meeting the relevant functional specification.

Overhead Transmission Lines

Construction of the proposed overhead transmission lines requires the following works to be undertaken:

- Site establishment including the provision of access.
- Centreline surveying and service location.

- Easement preparation, including the lopping and / or removal of trees.
- Excavation and transmission pole erection.
- Conductor and earth wire installation (including pilot wire).

Underground Transmission Lines

During WTG and electrical compound base construction, the underground transmission lines would be installed. This would involve the cutting or excavation of trenches for the laying of the underground transmission lines that link the Project components. The general procedure for the laying of underground transmission lines will be as follows:

- Establishment of trenches.
- Laying of bunded cables.
- Backfilling and compaction of excavated area.

All trenches would be marked with warning tape and backfilled once the cables were in-situ. On completion the underground transmission lines may be marked with small marker posts and the surrounding vegetation will be allowed to regrow.

OTHER ELECTRICAL INFRASTRUCTURE

Clearing and excavations will be undertaken, and reinforced concrete foundations will be constructed to support electrical infrastructure and buildings. Infrastructure required within the yard will include transformers, switchgear, power conditioning equipment, energy storage technology, switch room, cabling, and backup generators. The Substations will be designed and constructed in line with TransGrid requirements and any other relevant technical, electrical, and planning standards.

WIND TURBINE GENERATORS

Excavation of the WTG foundations will be undertaken to prepare the area for concrete pouring and WTG installation. Each foundation would be excavated, blinding layer of concrete placed, shuttering and steel reinforcement would be put in place and concrete poured to form the base in-situ.

If rock anchor foundations are required, the rock anchor cores would be drilled into the bedrock prior to concrete pour. The rock anchor tendons are grouted into place, stressed, and secured once the concrete has cured sufficiently. Steel form shuttering and steel reinforcement would then be put in place and concrete poured to form the base in-situ. The upper surface of each base would finish at ground level with either a central reinforced concrete plinth to support the tower, or a base steel tower section set into the concrete.

Erection of WTGs is generally a two-stage process with the base and first two tower sections lifted into place. This generally takes one day to complete. Once this has been completed various minor works are undertaken before the remaining tower sections, nacelle, generator, hub, and blades are lifted into place. This can take three days to complete depending on the prevailing weather conditions.

Both mobile cranes and tower crane methods are considered appropriate for this Project.

3.4.2.4. Commissioning

Pre-commissioning checks will be carried out on the high voltage electrical equipment prior to connection to the TransGrid transmission network. When the Project's electrical system has been energised, the WTGs and Substation will be commissioned and put into service. WTGs are commissioned sequentially enabling some WTGs to commence operation prior to the completion of wind farm construction.

3.4.2.5. Operations and Maintenance

Once operational, the Project would be monitored both by on-site staff and through remote monitoring. Aspects of the Project operation to be dealt with by on-site staff would include safety management, environmental condition monitoring, landowner management, routine servicing, malfunction rectification and site visits. Those functions to be overseen by remote monitoring include WTG and Substation performance assessment, Project reporting, remote resetting, and maintenance co-ordination.

On-site maintenance will require permanent access to the WTGs and Substation to address technical and mechanical servicing requirements. Replacement of major components, such as WTG blades, may require the use of cranes and ancillary equipment.

Management of regrowth and existing vegetation will be necessary within the overhead transmission line corridors to reduce the threat of fire and physical damage to the transmission line, and to allow access for maintenance vehicles. This will be carried out using mechanical, manual, and chemical clearing methods prior to construction activities commencing and as part of ongoing maintenance activities for the duration of the Project.

3.4.2.6. Decommissioning

At the end of the operational life of the Project, all above ground infrastructure will be dismantled and removed from the Project Site. This may not include the connection infrastructure which may be essential to be retained. WTG tower bases would be cut back to below ploughing level or topsoil built up over the foundation to achieve a similar result. The land will be returned to near prior condition and use.

Internal roads, if not required for ongoing farming purposes or fire access, would be removed and the Project Site reinstated as close as possible to its original condition and use. Access gates, if not required for farming purposes, would also be removed. Individual landowners will be involved in any discussion regarding the removal or hand-over of infrastructure on their property.

CHAPTER 4

Statutory Context

In meeting contemporary community expectations for environmental and social impacts, the Project must respond to established statutory requirements at a Commonwealth, state, and local government level. In doing so, the Project demonstrates its validity and conformance with contemporary expectations.

This section addresses compliance requirements under Commonwealth, state, and local legislation relevant to the Project, including NSW State Environmental Planning Policies (SEPPs) and LEPs along with any additional approvals, licenses or permits that are required for the Project.

The relevant statutory requirements for the Project are summarised in Table 4-1. Detailed summaries of the statutory compliance of the Project, relevant statutory pre-conditions and mandatory considerations can be found in Appendix C.

Table 4-1: Statutory requirements for the Project

Category	Relevance to the Project
Power to Grant Approval	In accordance with Part 2.2, Clause 2.6 of the *Planning Systems SEPP 2021*, development is declared to be SSD for the purposes of the EP&A Act if: *the development on the land concerned is, by the operation of an environmental planning instrument, not permissible without development consent under Part 4 of the Act, and* *the development is specified in Schedule 1 or 2.* Clause 20 of Schedule 1 of the Planning Systems SEPP states that "*development for the purpose of electricity generating works or heat or their co-generation (using any energy source, including gas, coal, biofuel, distillate, waste, hydro, wave, solar or wind power) that have a capital investment value of more than $30 million*" shall be classified as SSD under Division 4.7 of the EP&A Act. The Project has a capital investment value estimated to be greater than $30 million, and therefore is declared to be SSD. The Minister for Planning is the consent authority for SSD applications. SSD applications are assessed by DPE, and in some cases the Minister may delegate decision making to Department staff. However, the Independent Planning Commission (IPC) will be the consent authority for SSD applications where the relevant council objects, more than 50 objections are received in response to public exhibition of the EIS and/or the applicant has a reportable political donation (clause 2.7, Planning Systems SEPP). None of these requirements have been met for the Project at this stage.
Permissibility	The Project Site is located within both the Dubbo Regional Council and Mid-Western Regional Council LGAs. The land on which the Project is proposed to be located land to which both the Dubbo LEP 2022 and the Mid-Western LEP 2012 apply. The Project Site is situated on land zoned as RU1 (Primary Production) and adjacent to land zoned as RU3 (Forestry). Wind energy systems are prohibited in the RU1 Zone; however, pursuant to clause 2.35(1)(b) of the Transport and Infrastructure SEPP, development for the purpose of electricity generating works may be carried out by any person with consent on any land in a prescribed rural, industrial, or special use zone. Given that the Project is located on prescribed rural land, and the proposed activity is to generate electricity from wind, the Project is defined as electricity generating works (wind energy systems) and is permissible with consent under clause 2.36(1)(b) of the Transport and Infrastructure SEPP. Additionally, in relation to any part of the development that may, of itself, be prohibited (such as small lot subdivisions), it may nevertheless be granted consent due to the operation of section 4.38(3) of the EP&A Act.

Category	Relevance to the Project
Other Approvals	**Consistent Approvals** In accordance with Section 4.42 of the EP&A Act, an authorisation of the following relevant approvals cannot be refused if it is necessary for carrying out SSD that is authorised by a development consent under Division 4.7 of the Act and is to be substantially consistent with the consent: • An Environmental Protection Licence (EPL) under Chapter 3 of the *Protection of the Environment Operations Act 1997* (POEO Act) (for any of the purposes referred to in Section 43 of the Act). • A consent under Section 138 of the *Roads Act 1993* (Roads Act). **EPBC Act Approval** The Project has the potential to have a significant impact on EPBC listed threatened species and a Referral to DAWE was therefore undertaken. The Project was considered a Controlled Action on 17 August 2021 and will be assessed in a manner specified in Schedule 1 to the Bilateral Agreement made under Section 45 of the EPBC Act. **Other Approvals** A summary of approvals and licences that may be required for the Project prior to construction include: • Approval under Section 138 of the Roads Act to undertake upgrade works in, on or over a public road to allow for the transportation of WTG infrastructure. • A Licence in accordance with Part 5, Division 5.6 of the *Crown Land Management Act 2016*. • An EPL under Section 48 of the POEO Act for the regulation of noise pollution during both the construction and operational phases of the Project. It is noted that an EPL may also be required during the construction phase for crushing, grinding, or separating if the activity has the capacity to process more than 150 tonnes of materials per day or 30,000 tonnes of materials per year. **Approvals Required if this was not an SSD Project** Although all relevant environmental impacts have been assessed in this EIS, due to the Project's nature and being SSD, there are several approvals and licences, as listed in Section 4.41 of the EP&A Act, that are not required. These include: • Applications for separate permits under Sections 201, 205 or 219 of the *Fisheries Management Act 1994* (FM Act) however, the offset policy still applies. • Applications for separate approvals under Sections 89, 90 and 91 (other than an aquifer interference policy) of the *Water Management Act 2000* (WM Act). • An Excavation Permit under Section 139 of the *Heritage Act 1977* (Heritage Act). • A Bushfire Safety Authority under Section 100B of the RF Act. • An Excavation Permit under Section 139 of the Heritage Act • An Aboriginal Heritage Impact Permit (AHIP) under Section 90 of the *National Parks and Wildlife Act 1974* (NPW Act).
Pre-Condition to Exercising the Power to Grant Approval	No pre-conditions to exercising the power to grant approval have been identified for the Project.
Mandatory Matters for Consideration	The following Acts, Regulations and Environmental Planning Instruments (EPIs) are applicable to the project: COMMONWEALTH LEGISLATION • *Civil Aviation Act 1988* • *Civil Aviation Safety Regulation 1998* (CAS Regulation) • EPBC Act

Category	Relevance to the Project
	• *Hazardous Waste (Regulation of Exports and Imports) Act 1989* (Hazardous Waste Act) • *Native Title Act 1993* • *Radiocommunications Act 1992* (Radiocommunications Act) • *Renewable Energy (Electricity) Act 2000* (RE Act) STATE LEGISLATION • *Biodiversity Conservation Act 2016* (BC Act) • *Biosecurity Act 2015* (Biosecurity Act) • EP&A Act • FM Act • Heritage Act • *Mining Act 1992* (Mining Act) • NPW Act • POEO Act • Roads Act • *Rural Fires Act 1997* (RF Act) • *Waste Avoidance and Resource Recovery Act 2001* (WARR Act) • WM Act PLANNING INSTRUMENTS • *State Environmental Planning Policy (Resilience and Hazards) 2021* (Resilience and Hazards SEPP) • *State Environmental Planning Policy (Biodiversity and Conservation) 2021* • *State Environmental Planning Policy (Resources and Energy) 2021* • *State Environmental Planning Policy (Primary Production) 2021* • Transport and Infrastructure SEPP • Planning Systems SEPP • Dubbo Regional LEP 2022 • Dubbo LSPS • Mid-Western Regional LEP 2012 • Mid-Western LSPS • Central West and Orana Regional Plan 2041 GUIDELINES • National Airports Safeguarding Framework 2012 The mandatory matters for consideration for the above are detailed in Appendix C.

4.1. Subdivision

TransGrid have advised that as part of connecting the Project to their existing 330 kV network they would require a sub-divided block of land for the substation or switching station. The TransGrid network infrastructure will be owned by the Electricity Ministerial Holding Corporation (ETMHC) which will lease the infrastructure to TransGrid as part of the State's 99-year network lease arrangements with TransGrid. The site will need to be transferred as freehold title into the ETMHC's name.

Preliminary subdivision details and transfer of ownership to Transgrid (the ETMHC) for the two grid connection switchyard options are as outlined Figure 4-1 and Figure 4-2. The actual size, dimensions and location of the switchyard land will be determined during the connection application process. The land size, dimensions, location, and orientation will be determined as the connection process is progressed with TransGrid. The expected size of the switching station is approximately 100 m x 200 m (2 ha).

Two (2) possible switching station locations have been identified and assessed, although only one (1) will be required. These are located on the following land parcels:

- Lot 124 / DP756871
  - Preliminary subdivided Lot B – 6 ha
  - Residual Lot A – 116 ha
- Lot 40 / DP756882
  - Preliminary subdivided Lot B – 6 ha
  - Residual Lot A – 324 ha

A subdivision certificate will be required under Part 6 of the EP&A Act. Selection of the final connection configuration will be completed as part of the final Project layout and prior to the application for the subdivision certificate. Depending on which of the options are progressed, the residual lot may contain other Permanent or Temporary Facilities. Other minor boundary adjustments or realignments may be required as part of the Project layout finalisation, including adjustments to Crown Road reserves.

Figure 4-1: Subdivision Grid connection switchyard option 1

Figure 4-2: Subdivision grid connection switchyard option 2

4.2. Land Zoning

The Project Site is situated on land zoned as RU1 (Primary Production), C3 (Environmental Management), RE2 (Private Recreation) and W1 (Natural Waterways) (Figure 4-3). Wind energy systems are prohibited under the Mid-Western Regional and Dubbo Regional Council LEPs in the RU1 Zone; however, pursuant to clause 2.36(1b) of the Transport and Infrastructure SEPP, development for the purpose of electricity generating works may be carried out by any person with consent on any land in a prescribed rural, industrial, or special use zone. Given that the Project is located on prescribed rural zone (RU1), and the proposed activity is to generate electricity from wind, the Project is defined as electricity generating works (wind energy systems) and is permissible with consent under clause 2.36(1b) of the Transport and Infrastructure SEPP.

In accordance with Clause 4.38(3) of the EP&A Act, development consent may be granted despite the development being partly prohibited by an environmental planning instrument. This EIS therefore provides a merit-based assessment, addressing the objectives of the C3, RE2 and W1 zonings and providing justification for the Project. This is further detailed in Table 4-2 below.

4.3. Public Notification Development Pathway

On 8 May 2023 and 12 July 2023, the Proponent submitted a request for designation of the Project as public notification development pursuant to section 23 of the EP&A Regulation. The expected designation as a public notification development will facilitate the process for the planning approval, reconfiguration of the relevant road reserves and proposed upgrade works on the public road network to enable the delivery of the oversize WTG components to the Project Site.

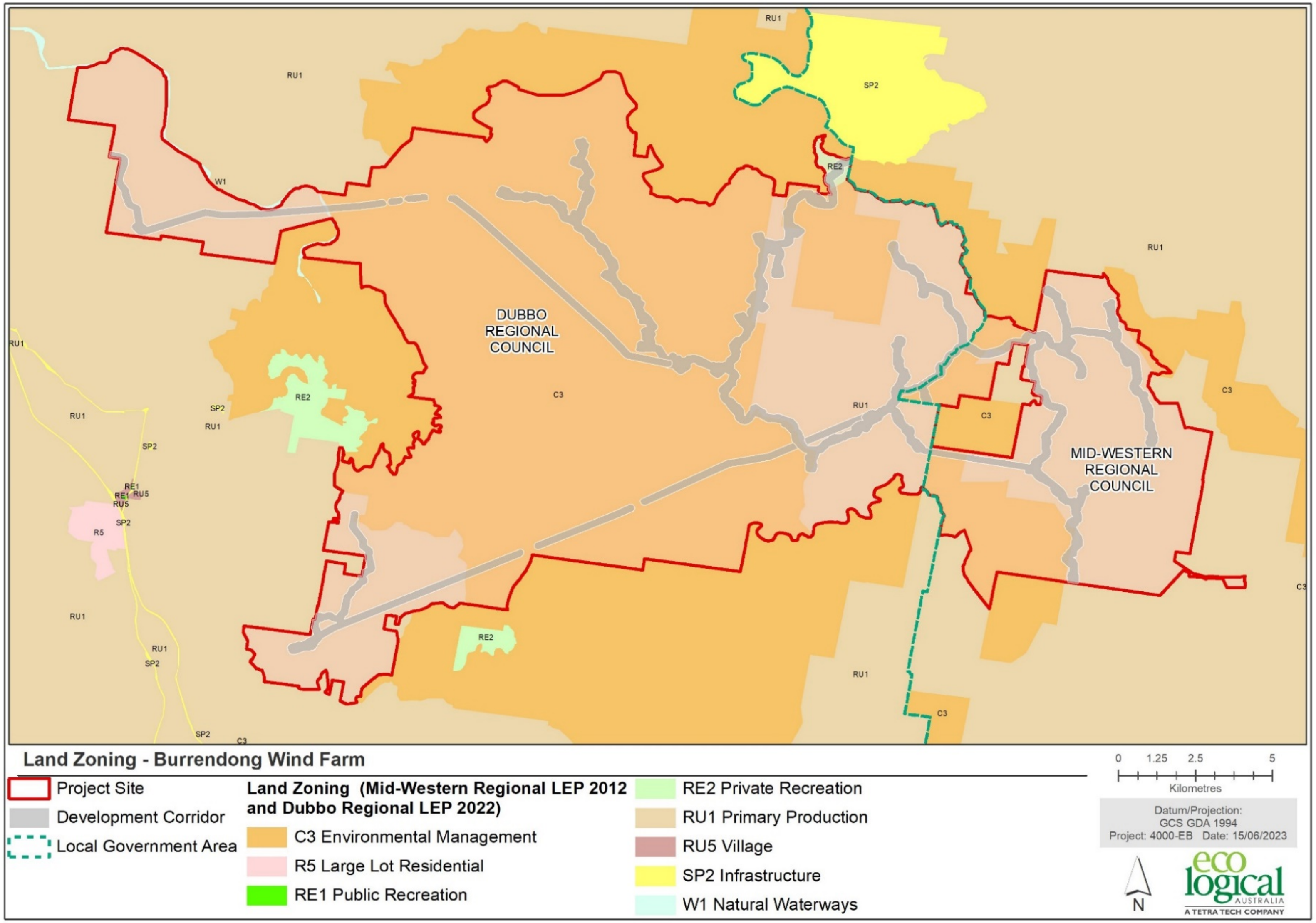


Figure 4-3: Land zoning

Table 4-2: Compatibility of the Project with the zoning objectives (Mid-Western Regional LEP and Dubbo Regional LEP)

Local Environmental Plan	Land Zoning	Objective	Compatibility
Mid-Western Regional LEP 2012	C3 (Environmental Management)	To protect, manage and restore areas with special ecological, scientific, cultural, or aesthetic values.	There is currently 1 WTG proposed within the C3 zoning within the Mid-Western Regional LGA and 29 WTGs within the C3 zoning within the Dubbo Regional LGA. The proposed WTGs located on C3 land are critical to delivering the benefits associated with the Project and will contribute approximately 450 MW of additional generating capacity (based on the assumption of each WTG generating approximately 6-7 MW). **Ecological Values** The Project Site was selected due to its suitability for a wind farm based upon the available wind resource within the Project Site and environmental and social constraints identified through preliminary investigations. The proposed Project layout is the result of comprehensive modelling, investigations and consultation and has been chosen to reduce impacts on native vegetation, flora, and fauna where practical. Impacts to ecological values have been minimised by: • Avoiding areas of high conservation value and/or native vegetation, where possible. • Minimising the amount of land disturbance needed for Project elements. • Using previously disturbed land for Project elements. The Project Site has been assessed so that the Development Footprint (approximately 781 ha) can be micro-sited to avoid and reduce impacts to native vegetation, flora, and fauna. The location of roads, tracks, placement of WTGs and powerline connection corridors will be micro-sited to minimise impacts. Additional surveys will be undertaken to ensure impacts will be avoided where possible, or minimised. The broader strategic benefits of the project will protect ecological values by minimising reliance on fossil fuel generated energy, thereby contributing to action on climate change. **Cultural and Scientific Values** Impacts to cultural values have been minimised by avoiding areas of high cultural value, where possible. The Macquarie River and its higher order tributaries were identified to be of high cultural and archaeological potential. This is due to the river being a permanent source of water supporting rich, biodiverse focal points in the landscape and are likely to have sustained greater levels of occupation. Artefact density along Little Oakey Creek was found to be high and artefact complexity was greater than on other landforms. This area will be avoided by the Project, wherever possible, and subject to relevant protection measures. Design evolution of the Project layout has also avoided the highest density Aboriginal sites. **Aesthetic Values**

Local Environmental Plan	Land Zoning	Objective	Compatibility
			A Community Survey of Landscape Values was undertaken (MLA, 2023; Appendix F) to assist in identifying key landscape values. The three most highly valued aspects of the local community, in order of importance, were community and people, farming and agriculture and landforms and terrain. Local rivers and creeks, Wellington Caves and rocky hills and outcrops were considered to hold the most scenic value. Impacts to these identified landscape features were concluded to be low – moderate due to steep topography and dense vegetation surrounding the Project. To further reduce aesthetic impacts to the landscape, mitigation measures such as WTG and infrastructure design and vegetation screening will be implemented. There is increasing evidence that wind farms can provide a new source of tourism and revenue, as seen by the popularity of tourist visits at farms such as the Woodlawn Wind Farm near Tarago, NSW. The increase in popularity of wind farms has the additional benefit of driving tourism to the locality, contributing to the local economy and supporting the protection of C3 land.
		To provide for a limited range of development that does not have an adverse effect on those values.	National, State, Regional and Local legislation and planning strategies are increasingly signalling the need for increased renewable energy generation. Regional areas have been consistently determined to possess incredible amounts of renewable energy resources, and legislation is attempting to develop projects to capture these. The Project will significantly contribute to the goals of various policies and strategies, including the NSW Net Zero Plan which seeks to cut emissions in half by 2030, and the Dubbo LSPS Priority 3 which seeks to promote the generation of renewable energy. The purpose of C3 zoned land is to minimise impacts to the local environment, including the restriction of most development. 30 WTGs have been proposed on C3 land, representing roughly 42.86% of the total proposed WTGs for the Project. Given that the individual WTG foundations will be around 35 m^2, the individual development impact will be limited, yet the net positives of renewable energy generation resulting from the Project as part of the broader REZ and decarbonisation of energy production contributes to efforts in protecting and managing the long-term environmental integrity of the land. In comparison to other forms of development prohibited on C3 land, individual WTGs require a limited amount of space and ancillary infrastructure and will therefore have a limited footprint on the broader C3 landscape. Allowing limited WTG development on the land will also provide localised benefits to the environment in the form of access roads as they provide fire breaks and reduce bushfire hazards. The ongoing management of these access roads will allow for better protection of C3 land from the threat of bushfire. Numerous technical studies have been undertaken to ensure that impacts on ecological, scientific, cultural, or aesthetic values are avoided or minimised wherever possible. In particular, the design has minimised vegetation clearing through strategic design. Various options for access and connection corridors were investigated to determine impacts to vegetation along each section. Although two options for the transmission corridor are proposed (Figure 1-2), the northern

Local Environmental Plan	Land Zoning	Objective	Compatibility
			corridor is the preferred option, due to the reduced impacts to native vegetation. Micro siting of WTG and infrastructure will further reduce the clearing footprint during the post-approval stage.
		To manage development within the water supply catchment lands of Windamere and Burrendong Dams, to conserve and enhance the district's water sources.	The nature of modern wind farms is to place the WTGs on often elevated, high wind ridges and hills to maximise the energy potential of the area. One effect of this placement is the limited anticipated impacts to both ground water supply and surface water. Both the surface water and groundwater assessments undertaken as part of this EIS determined that due to the location of the WTGs, all registered groundwater bores within 5 km of the Project are located at lower elevations. Additionally, the extrapolated water tables beneath the WTG sites are anticipated to be significantly deeper than the lowest point of the WTG foundation making it highly unlikely that a WTG will intercept the groundwater. The localised footprint of the WTGs within C3 land therefore are not anticipated to hinder the district's water sources. Wind farms as a renewable energy require little water resources upon completion of the construction phase. The limited requirement for water resources will be sought from appropriate water providers within the local area with the goal of conserving the district's water sources where possible. In the operational phase of the Project, the conservation of water in the district is assisted by the minimal impervious footprint of the individual WTGs and associated infrastructure and very short diversion paths at impervious locations which suggest minimal, to no, expected impact to recharge from the Project into tributaries, creeks, and streams.
		To minimise conflict between land uses within this zone and land uses within adjoining zones.	The Project has been designed in line with current wind farm practice of integrating WTGs within often large Project sites, despite their relatively small individual footprint. This allows for limited conflict between land uses as other uses including agricultural grazing can continue and adjacent to the Project site. The Project involves a temporary modification in land use of up to 3,058.08 ha (Development Corridor), accounting 0.01% of all land used for agriculture in the ABARES Far West and Orana region, for the duration of the Project life. This changed land use may temporarily reduce agricultural production. However, once constructed, existing agricultural activities will continue. Therefore, impacts of the Project on agricultural production at a regional level are very minimal. At the conclusion of the life of the Project, the Project would be decommissioned to permit the resumption of grazing activities or other agricultural uses. Additionally, WTGs have limited impacts beyond their footprint, particularly beyond the overall Project site. This allows many land uses on adjoining zones to remain unaffected by the construction and operation of a wind farm.
Dubbo Regional LEP 2022		To protect, manage and restore areas with special	See above.

Local Environmental Plan	Land Zoning	Objective	Compatibility
		ecological, scientific, cultural, or aesthetic values.	
		To provide for a limited range of development that does not have an adverse effect on those values.	See above.
	C3 (Environmental Management)	To allow for development that is compatible with the flood hazard of certain areas.	The development of the Project seeks to place WTGs on elevated ridgelines and other high elevation locations to capture the high wind energy potential of the area. As discussed above, the location of the WTGs and ancillary infrastructure is anticipated to have little impacts to current water courses. Where roads are constructed that intersect watercourses that may be prone to flooding, mitigation measures have been developed to appropriately address this constraint. Such measures include the potential development of crossings that enhance the stability of creek lines using revetment walls, pylons, or culverts. Additionally, construction in waterways and flood prone areas has been proposed to happen during periods of no-flow to minimise impacts to aquatic ecosystems. While located away from the Macquarie River, the Project site is within proximity to flood prone lands around Lake Burrendong. By constructing the Project in elevated locations, and with relatively small footprints, the Project is in line with the objective of low impact development on land that considers the flood prone nature of its surroundings.
		To provide for a range of recreational activities that do not have an adverse effect on areas with environmental and scenic values.	The construction of the Project is primarily located on private land and on elevated ridgelines and hills that are difficult to access for recreational purposes. The development of WTGs on C3 land will allow for a range of low impact recreational activities and ancillary land uses in the Burrendong State Park with no impacts to the recreational uses of Lake Burrendong. The Project also has the potential to enhance the scenic qualities of the park as there is an increasing popularity in the visitation of wind farms, with a likely increase in the number of visitors to the Burrendong State Park.
		To recognise the environmental significance of certain areas.	The Project is located primarily on previously cleared or agricultural land. The proposed Development Footprint has been modified and evaluated several times including the relocation and removal of WTGS to avoid impacts to Threatened Ecological Communities as better condition vegetation.
		To minimise the adverse effect of development on the salinity levels of certain land.	The Hydrogeological Landscape (HGL) boundaries (NSW SEED, 2016) show the Project Site has a generally low risk of land salinity, with small portions of medium risk and minor portions of high risk.

Local Environmental Plan	Land Zoning	Objective	Compatibility
	RE2 (Private Recreation)	To enable land to be used for private open space or recreational purposes.	The Project will not inhibit the continuality for the land to be used for private open space or recreational purposes.
		To provide a range of recreational settings and activities and compatible land uses.	The Project will not inhibit the continuality for the land to be used for private open space or recreational purposes.
		To protect and enhance the natural environment for recreational purposes.	No WTGs or related infrastructure are proposed within the RE2 zoning. Therefore, no impacts to the natural environment for recreational purposes is anticipated.
	W1 (Natural Waterways)	To protect the ecological and scenic values of natural waterways.	Section 6.5 details the anticipated impacts of the Project on the ecological and scenic values of the waterways within and surrounding the Project site. Seeking to capitalise on the high wind energy potential of the area, the placement of the WTGs has been proposed on ridgelines and areas of high elevation. This placement is largely inverse to the location of various waterways, creeks, tributaries, and bodies of water within the Project site and adjacent Lake Burrendong. Section 6.11 determined that the location and foundational depths of the WTGs and ancillary infrastructure is unlikely to impact the ecological values of these waterways. Additionally, measures will be taken to minimise potential impacts to waterways where waterway crossings are required.
		To prevent development that would have an adverse effect on the natural values of waterways in this zone.	See above.
		To provide for sustainable fishing industries and recreational fishing.	Given the ephemeral nature of the majority of watercourses found within the Project Site, it is unlikely that industrial or recreational fishing would occur on site and therefore the Project would not be anticipated to impact on the ability for fishing on nearby W1 zoned land.

CHAPTER 5

Community Engagement

5.1. Approach

Ark Energy understands the importance and benefits to all parties of effective and comprehensive consultation with local community members and other key stakeholders.

Ark Energy's approach to consultation is informed by the International Association for Public Participation's (IAP2) Core Values and Public Participation Spectrum, widely accepted as the benchmark for good community consultation. The IAP2 Core Values states that public participation:

- Is based on the belief that those who are affected by a decision have a right to be involved in the decision-making process.
- Includes the promise that the public's contribution will influence the decision.
- Promotes sustainable decisions by recognising and communicating the needs and interests of all participants, including decision-makers.
- Seeks out and facilitates the involvement of those potentially affected by or interested in a decision.
- Seeks input from participants in designing how they participate.
- Provides participants with the information they need to participate in a meaningful way.
- Communicates to participants how their input impacted or changed the decision.

5.1.1. Consistency with Relevant Guidelines

The approach centres on achieving good community-based outcomes and can be described as genuine, timely, relevant, transparent, and inclusive.

In undertaking community engagement, the Project team also took guidance from:

- Wind Energy Guideline for State Significant Wind Energy Development (Wind Energy Guideline) (DPE, 2016a)
- Wind Energy: Visual Assessment Bulletin for State Significant Wind Energy Development (Visual Bulletin) (DPE, 2016b)
- Wind Energy: Noise Assessment Bulletin for State Significant Wind Energy Development (Noise Bulletin) (DPE, 2016c)
- Community Engagement Guidelines for the Australian Wind Industry (CEC, 2018)
- Best Practice Guidelines for Implementation of Wind Energy Projects in Australia (CEC, 2018).
- Community Consultative Committee Guidelines State Significant Projects (DPE, 2019).
- Undertaking Engagement Guidelines for State Significant Projects (DPIE, 2021b)
- Social Impact Assessment Guideline for State Significant Projects (DPE,2023b)

Ark Energy is also signatory to the Clean Energy Council's (CEC) Best Practice Charter for Renewable Energy Projects, a voluntary commitment to engage respectfully with communities, be sensitive to environmental and cultural values, and make a positive contribution to the regions in which we operate (Figure 5-1).

CLEAN ENERGY COUNCIL

BEST PRACTICE CHARTER FOR RENEWABLE ENERGY PROJECTS

We commit to honouring the Clean Energy Council's Best Practice Charter in our renewable energy projects and associated transmission infrastructure:

1. We will engage respectfully with the local community, including Traditional Owners of the land, to seek their views and input before submitting a development application and finalising the design of the project.
2. We will provide timely information and be accessible and responsive in addressing the local community's feedback and concerns throughout the life of the project.
3. We will be sensitive to areas of high biodiversity, cultural and landscape value in the development and operation of projects.
4. We will minimise the impacts on highly productive agricultural land and explore opportunities to integrate agricultural production.
5. We will consult the community on the potential visual, noise, traffic and other impacts of the project, and on the mitigation options.
6. We will support the local economy by providing local employment and procurement opportunities.
7. We will offer communities the opportunity to share in the benefits of the project, and consult them on the options available, including relevant governance arrangements.
8. We commit to using the project to support educational and tourism opportunities where appropriate.
9. We will demonstrate responsible land stewardship over the life of the project and welcome opportunities to enhance the ecological, cultural and/or agricutural value of the land.
10. During the life of the project, we will recycle waste materials where feasible and commit to responsible decommissioning or refurbishment/repowering of the site at the end of the project's life.

Daniel Kim
Chief Executive Officer
Ark Energy Corporation
Signatory since October 2022

ARK ENERGY

Figure 5-1: Clean Energy Council's Best Practice Charter for Renewable Energy Projects

5.1.2. Ark Energy's Engagement Goals and Commitments

Ark Energy's goals for engagement:

- Ensure stakeholders were well informed and kept up to date on Project status and developments.
- Obtain feedback and provide ample opportunities for stakeholders to communicate their views, concerns, and aspirations for the Project.
- Address any stakeholder issues or concerns promptly.
- Work to minimise the impacts and maximise the benefits of the Project for the local community.
- Wherever possible utilise stakeholder input to optimise the design of the Project.

In implementing engagement for the Project Ark Energy committed to:

- Be proactive – regularly share information so stakeholders knew what was happening and how they could interact with and provide feedback on the project.
- Be transparent – be honest and ethical in our dealings with all.
- Seek solutions – engage to understand and explore ways to minimise impacts and maximise the benefits of the project.
- Be flexible and inclusive – ensure that our engagement provided opportunities for all interested stakeholders to have access to information and project personnel.
- Continually improve – evaluate the effectiveness of engagement and iteratively adapt the approach and activities as required.

5.2. Engagement Undertaken to Date

5.2.1. Key Stakeholders

Stakeholders consulted to date for the Project include:

- Landowners:
    - Nearby landowners and residents
    - Residents and property owners within 5 km of proposed WTGs
    - Residents and property owners along the proposed transport route.
- Traditional Owners and Custodians:
    - Warrabinga-Wiradjuri #7 Native Title Claimant
    - Gallanggabang Aboriginal Corporation
    - Mudgee Local Aboriginal Council
    - Wellington Local Aboriginal Council.
- Residents and Community Members:
    - For the localities of Yarrabin, Hargraves, Twelve Mile and Mudgee.
    - Including opposition Group, Burrendong Save Our Surroundings (Burrendong SOS)
- Government Authorities and Agencies:
    - Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW), previously the Department of Agriculture, Water, and the Environment (DAWE)
    - Commonwealth DoD
    - NSW DPE Biodiversity, Conservation and Science (BCS)
    - NSW DPE– Heritage NSW
    - NSW Aboriginal Land Council (ALC)
    - NSW DPE Water Group
    - WaterNSW
    - NSW Crown Lands
    - NSW Crown Holiday Park Land Manager (Reflections Holiday Parks)

  - Regional NSW – Mining, Exploration and Geoscience (MEG)
  - TfNSW
  - NSW DPI – Agriculture Land Use and Fisheries Divisions
  - MWRC
  - DRC
  - Central West Local Land Services NSW (CWLLS)
  - Fire & Rescue NSW
  - NSW Rural Fire Service (RFS)
  - NSW Spatial Services
  - CASA
  - Bureau of Meteorology (BoM).

- Other Organisations and Stakeholders:

  - Air Services Australia (AsA)
  - John Holland Rail / UGL Regional Linx (UGLRL) – Country Regional Network (CRN)
  - TransGrid and ETMHC
  - Mining and exploration licence holders.

5.2.2. Actions Undertaken

Ark Energy has used a variety of methods to communicate and consult with stakeholders.

5.2.2.1. Dedicated Communication Channels

The Project has a dedicated email address info@burrendongwindfarm.com.au and 1800 number for general enquiries. These have been promoted in all community materials and divert to members of the Project team.

5.2.2.2. Project Website

Since early 2020, the Project has had a website accessible directly via the domain name www.burrendongwindfarm.com.au (Figure 5-2). The website has been promoted through all community communications and information materials. It provides an overview of current project information, maps, contact details, archives of published newsletters and an online feedback form. Visitors are also encouraged to register for project updates.

Since early 2020 the Project has had a website accessible directly via the domain name www.burrendongwindfarm.com.au (Figure 5-2). The website has been promoted through all community communications and information materials. It provides an overview of current project information, maps, contact details, archives of published newsletters and an online feedback form. Visitors are also encouraged to register for project updates.

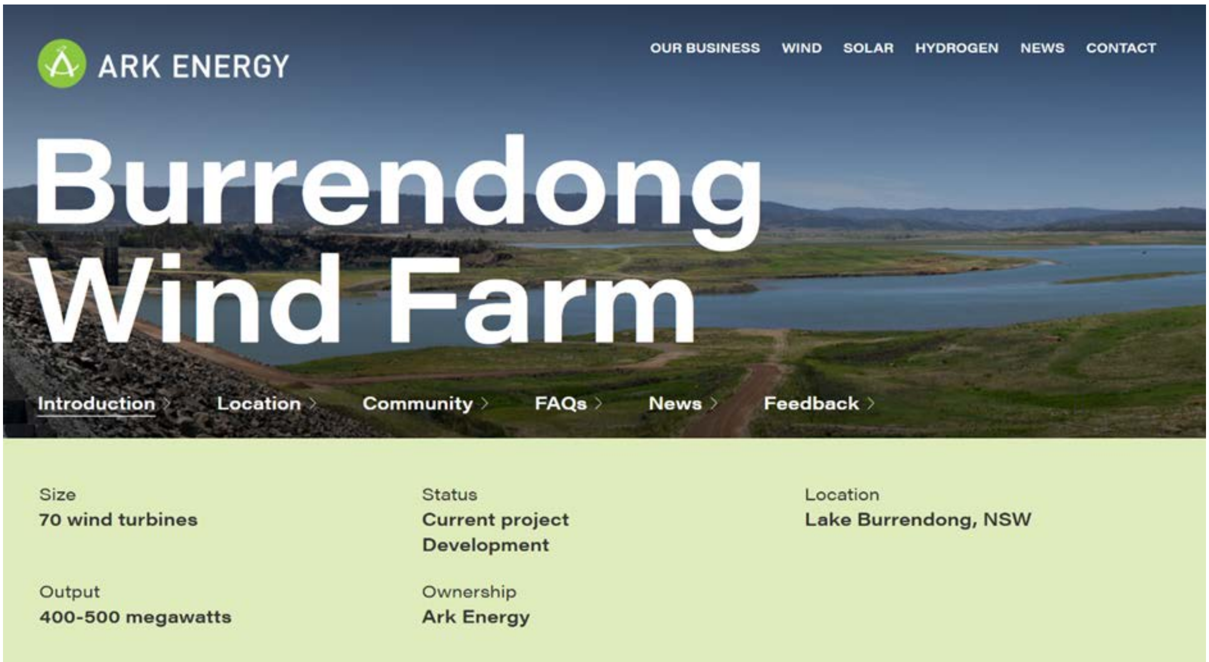


Figure 5-2: Project website landing page

5.2.2.3. Direct Correspondence

The Project team has maintained direct, regular correspondence with key stakeholders via telephone and email, and endeavoured to respond directly to enquiries within 48 hours of receipt.

5.2.2.4. Newsletters

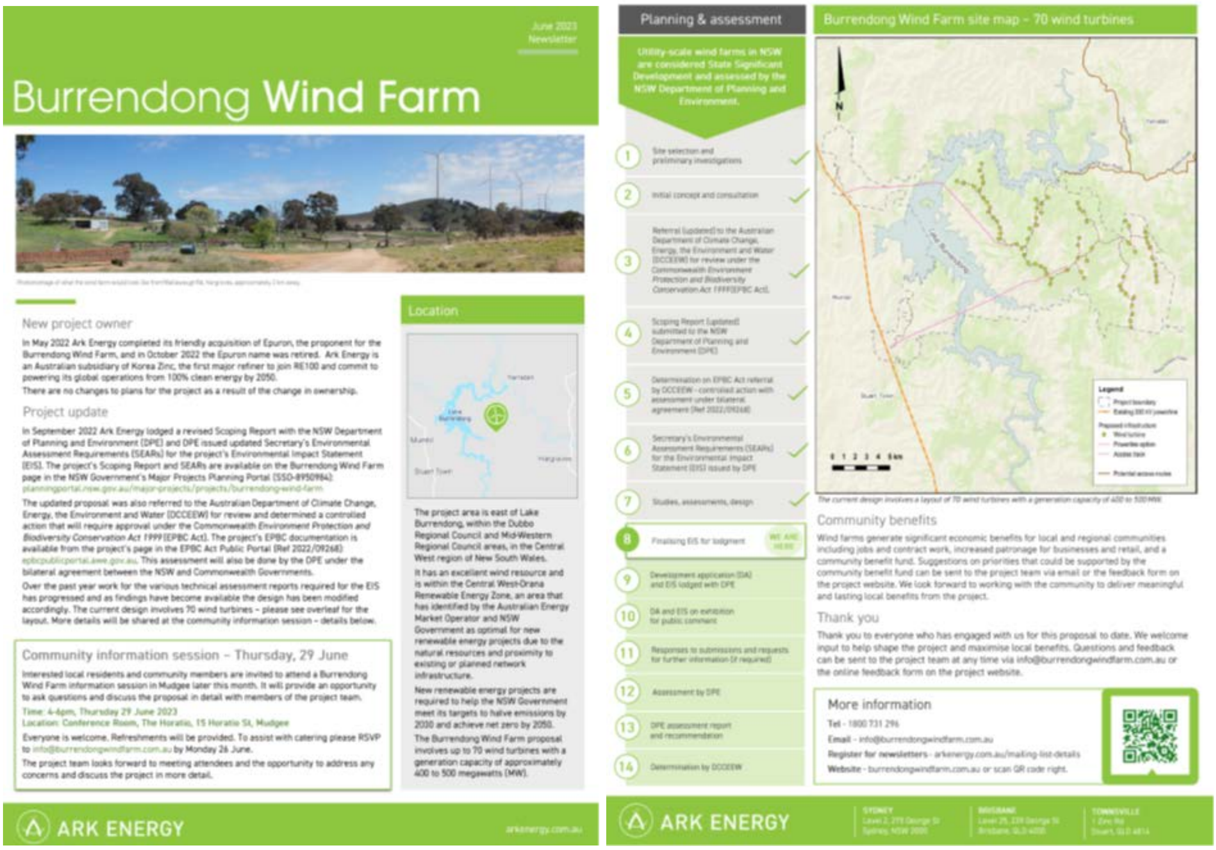
Project newsletters have been produced in both print and digital formats and sent directly via post and email to approximately 125 stakeholders, and to approximately 410 subscribers to Ark Energy's e-news who have opted in to receive updates on the Project. The content has explained:

- Latest Project activities.
- Map with location and design.
- Steps and the Project's status in the planning and assessment process.
- Opportunities to provide input.
- Project website address and contact details.

To date seven newsletters have been issued:

- May 2020
- September 2020
- December 2020
- September 2021
- November 2021
- March 2022
- June 2023 (Figure 5-3)

All issued newsletters are available under the 'Community' and 'News' sections of the Project website.



June 2023 Newsletter

Burrendong Wind Farm

New project owner

In May 2022 Ark Energy completed its friendly acquisition of Epuron, the proponent for the Burrendong Wind Farm, and in October 2022 the Epuron name was retired. Ark Energy is an Australian subsidiary of Korea Zinc, the first major refiner to join RE100 and commit to powering its global operations from 100% clean energy by 2050.

There are no changes to plans for the project as a result of the change in ownership.

Project update

In September 2022 Ark Energy lodged a revised Scoping Report with the NSW Department of Planning and Environment (DPE) and DPE issued updated Secretary's Environmental Assessment Requirements (SEARs) for the project's Environmental Impact Statement (EIS). The project's Scoping Report and SEARs are available on the Burrendong Wind Farm page in the NSW Government's Major Projects Planning Portal (SSD-8950984): planningportal.nsw.gov.au/major-projects/projects/burrendong-wind-farm

The updated proposal was also referred to the Australian Department of Climate Change, Energy, the Environment and Water (DCCEEW) for review and determined a controlled action that will require approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The project's EPBC documentation is available from the project's page in the EPBC Act Public Portal (Ref 2022/09268): epbcpublicportal.awe.gov.au. This assessment will also be done by the DPE under the bilateral agreement between the NSW and Commonwealth Governments.

Over the past year work for the various technical assessment reports required for the EIS has progressed and as findings have become available the design has been modified accordingly. The current design involves 70 wind turbines – please see overleaf for the layout. More details will be shared at the community information session – details below.

Community information session – Thursday, 29 June

Interested local residents and community members are invited to attend a Burrendong Wind Farm information session in Mudgee later this month. It will provide an opportunity to ask questions and discuss the proposal in detail with members of the project team.

Time: 4-6pm, Thursday 29 June 2023
Location: Conference Room, The Horatio, 15 Horatio St, Mudgee

Everyone is welcome. Refreshments will be provided. To assist with catering please RSVP to info@burrendongwindfarm.com.au by Monday 26 June.

The project team looks forward to meeting attendees and the opportunity to address any concerns and discuss the project in more detail.

Location

The project area is east of Lake Burrendong, within the Dubbo Regional Council and Mid-Western Regional Council areas, in the Central West region of New South Wales.

It has an excellent wind resource and is within the Central West-Orana Renewable Energy Zone, an area that has identified by the Australian Energy Market Operator and NSW Government as optimal for new renewable energy projects due to the natural resources and proximity to existing or planned network infrastructure.

New renewable energy projects are required to help the NSW Government meet its targets to halve emissions by 2030 and achieve net zero by 2050.

The Burrendong Wind Farm proposal involves up to 70 wind turbines with a generation capacity of approximately 400 to 500 megawatts (MW).

ARK ENERGY arkenergy.com.au

Planning & assessment

Utility-scale wind farms in NSW are considered State Significant Development and assessed by the NSW Department of Planning and Environment.

1. Site selection and preliminary investigations
2. Initial concept and consultation
3. Referral (updated) to the Australian Department of Climate Change, Energy, the Environment and Water (DCCEEW) for review under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
4. Scoping Report (updated) submitted to the NSW Department of Planning and Environment (DPE)
5. Determination on EPBC Act referral by DCCEEW - controlled action with assessment under bilateral agreement (Ref 2022/09268)
6. Secretary's Environmental Assessment Requirements (SEARs) for the Environmental Impact Statement (EIS) issued by DPE
7. Studies, assessments, design
8. Finalising EIS for lodgment — WE ARE HERE
9. Development application (DA) and EIS lodged with DPE
10. DA and EIS on exhibition for public comment
11. Responses to submissions and requests for further information (if required)
12. Assessment by DPE
13. DPE assessment report and recommendation
14. Determination by DCCEEW

Burrendong Wind Farm site map – 70 wind turbines

The current design involves a layout of 70 wind turbines with a generation capacity of 400 to 500 MW.

Community benefits

Wind farms generate significant economic benefits for local and regional communities including jobs and contract work, increased patronage for businesses and retail, and a community benefit fund. Suggestions on priorities that could be supported by the community benefit fund can be sent to the project team via email or the feedback form on the project website. We look forward to working with the community to deliver meaningful and lasting local benefits from the project.

Thank you

Thank you to everyone who has engaged with us for this proposal to date. We welcome input to help shape the project and maximise local benefits. Questions and feedback can be sent to the project team at any time via info@burrendongwindfarm.com.au or the online feedback form on the project website.

More information

Tel - 1800 731 296
Email - info@burrendongwindfarm.com.au
Register for newsletters - arkenergy.com.au/mailing-list-details
Website - burrendongwindfarm.com.au or scan QR code right.

ARK ENERGY

Figure 5-3: June 2023 Newsletter

5.2.2.5. Local Public Information Sessions

Local public information sessions have been held in Mudgee to update the community, address concerns, and collect feedback (Figure 5-4).

To date community information events have been held on two occasions, in November 2021 and June 2023. Sessions were promoted in Project newsletters and the local newspaper the Mudgee Guardian. Two consecutive sessions on 25 November 2021 attracted a total of 19 attendees and one session on 29 June 2023 attracted 26 attendees, including some who also attended the November 2021 session. At the June 2023 session independent consultants for the EIS assessment for visual impact, ecology and social impact were also available to answer questions.

At each session a presentation was given by the Project team followed by discussion. Additional materials were provided including information sheets, third-party documents, photomontages from public viewpoints and a variety of maps.

All information provided to the community at information sessions is available under the 'News' section of the Project's website.

Figure 5-4: Photograph from public information sessions hosted in Mudgee, November 2021

5.2.2.6. In Person Meetings

Members of the Project team have met with key stakeholders and stakeholder groups, including local councils, neighbours and the Burrendong Save Our Surroundings action group, to provide updates, discuss concerns and source input.

5.2.2.7. Feedback Mechanisms

Multiple and ongoing channels for input and questions have been available including:

- Invitation to contact the Project team directly at any time promoted in all project materials.
- Online feedback form on the Project website. To date eight (8) online feedback forms have been received.
- Printed feedback forms at information sessions.

5.2.2.8. Community Consultative Committee

The Project's Community Consultative Committee (CCC) was established in 2020 and has provided an important conduit between the community and the Project team.

Independent chair appointed to the CCC in November 2020 by DPE is Garry West. Following Mr West's appointment Expressions of Interest for membership were sought through advertisements in local newspapers the Daily Liberal and Mudgee Guardian and a Project newsletter later that month (Figure 5-5).

Community members and stakeholder representatives were subsequently appointed to the CCC, and are:

- Bradley Bliss, stakeholder representative
- Chris Pilley, stakeholder representative

- Cr Sam Paine, Mid-Western Regional Council representative
- Heather Gough-Fuller, community member
- Jacqui Coates, community member
- James Mort, community member
- Justin Gard, community member.

To date the CCC has met on five occasions in Mudgee:

- Friday 28 May 2021
- Thursday 25 November 2021.
- Thursday 24 March 2022
- Thursday 17 November 2022
- Thursday 29 June 2023

CCC member contact details, meeting presentations and minutes are available under the 'Community' page of the Project website.

Figure 5-5: CCC advertisement in Daily Liberal and Mudgee Guardian (December 2021)

5.2.2.9. Central-West Orana Renewable Energy Zone Industry Roundtable

In 2021 the Project team joined an Industry Roundtable for the Central West-Orana Renewable Energy Zone (CWO REZ) convened by community advocacy organisation RE Alliance.

The CWO REZ Industry Roundtable aims to bring together proponents with projects in the CWO REZ, to discuss common challenges and collaborate on outcomes for the benefit of community stakeholders.

Members of the Project team attended several CWO REZ Roundtable meetings between July 2021 and June 2023, either in person in Dubbo or remotely via video conference.

5.3. Community Views

5.3.1. Key Findings

Across the engagement undertaken to date, the Proponent has identified both significant support for the Project as well as concerns.

Key reasons for support include the local benefits such as the economic stimulus, employment opportunities and the community benefit fund, as well as support in general for renewable energy targets and strategies to mitigate climate change.

Concerns raised include potential visual impact, noise, traffic, property values, changes to local road use during construction and lack of support for the wider renewable energy policy agenda.

Reasons for support and concern have been key considerations in iterations of the project design.

Consultation activity, matters raised to date, and how concerns have been addressed is set out in the following sections and further details on specific matters raised during consultation are summarised in Appendix D.

5.3.1.1. Landowners and Residents

A summary of the consultation undertaken to date with relevant landowners and neighbours is provided in Table 5-1.

Table 5-1: Summary of consultation undertaken to date with landowners and residents

Stakeholder	Geographic Location	Consultation	Issues Raised	Addressed in EIS
Residents and property owners with a dwelling located within 2 km of a WTG (~ 11)	Local	• Phone calls • Letters • Emails • Meetings	• Visual impact • Noise • Property values	Section 6.3 Section 6.4 Section 6.14
Residents and property owners with a dwelling 2 to 5 km of a WTG	Local	• Phone calls • Letters • Emails • Meetings	• Visual impact • Property values	Section 6.3 Section 6.14
Residents and property owners along the proposed transport route	Local	• Letters • Phone calls • Meetings	• Road design • Dust • Transport times	Section 6.6 Section 6.10

5.3.1.2. Traditional Owners and Custodians

A summary of the consultation undertaken to date with relevant traditional owners and custodians is provided in Table 5-2.

Table 5-2: Summary of consultation undertaken to date with traditional owners and custodians

Stakeholder	Geographic Location	Consultation	Issues Raised	Addressed in EIS
Warrabinga-Wiradjuri #7 Native Title Claimant	Regional	• Emails • Phone call	• Land claim	Section 6.8
Gallanggabang Aboriginal Corporation	Regional	• Emails • Phone calls • Meeting	• Heritage field survey	Section 6.8
Mudgee Local Aboriginal Council	Regional	• Email • Meeting	• Heritage field survey • Land claims	Section 6.8
Wellington Local Aboriginal Council	Regional	• Email	• Heritage field survey	Section 6.8

5.3.1.3. Government Authorities and Agencies

In accordance with the SEARs, the following Government agencies were required to be consulted with:

- DRC
- MWRC
- DPE – BCD
- Department of Premier and Cabinet – Heritage
- DPE – Water Group
- WaterNSW
- EPA
- Crown Lands
- Regional NSW –MEG
- DPI – Agriculture and Fisheries divisions
- John Holland Rail
- TfNSW
- TransGrid
- Department of Finance, Services, and Innovation – Telco Authority
- CWLLS
- Fire & Rescue NSW
- NSW RFS
- DoD
- CASA
- AsA

A summary of the outcomes of all consultation undertaken to date is outlined in Table 5-3 and Table 5-4. It is noted that in response to the SEARs, the EPA, in their letter dated 22/7/2022, stated that they ‘do not have any further comments or feedback on the Project’. Consultation was therefore not undertaken. Further, no consultation was undertaken with DPI – Fisheries, as relevant policies and guidelines were used during the aquatic ecological environmental assessment, including but not limited to, Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings and the associated Policy and Guidelines for Fish Habitat Conservation and Management (Update 2013).

Table 5-3: Summary of consultation undertaken to date with government authorities and agencies

Stakeholder	Consultation	Issues Raised	Addressed in EIS
Central West Local Land Services	• Email (no response)	• N/A	N/A
Commonwealth DCCEEW	• Meetings, emails	• Controlled Action	6.5
Commonwealth DoD	• Email	• WTG lighting	6.3.2.7
NSW DPE	• Scoping meeting on 10 Dec 2019 • Phone calls	• Zoning • Cumulative impacts • Access routes & road upgrades	3.3.1 4.2 6.6.3 6.15
DPE – BCD	• Meetings	• SEARs requirements for hydrology and biodiversity	6.5 6.11
DPE – Water	• Meeting	• SEARs requirements for surface water assessment and flooding	6.11
Heritage NSW	• Emails	• Request for list of RAPs • Summary of ACHA findings	6.8
WaterNSW	• Correspondence • Emails	• Dwelling locations	6.3.2.1 6.11
NSW Crown Lands	• Meetings	• Access & Land tenure	3.2.5
NSW Crown Holiday Park Land Manager – Reflections Holiday Parks	• Meetings, • phone calls	• Land tenure • Worker accommodation	6.13.1.2 6.14.2.5
NSW ALC	• Phone call	• Land claims process	6.8
Regional NSW – MEG	• Current mining & exploration licences in the area	• Consultation with licence holders	6.10.1.4
TfNSW	• Emails	• Traffic and transport	6.6
MWRC	• Meeting • Emails	• Transportation route • Socio-economic impacts • Water consumption • Neighbour engagement • Dwelling Das • Aerodrome operations	5.2 6.6 6.7 6.11 6.13 6.14
DRC	• Meeting • Emails	• Zoning • Aerodrome operations	3.3.1 4.2 6.7
NSW RFS	• Email	• Aerial firefighting.	6.7
Fire and Rescue NSW	• Email (Hargraves Bushfire Brigade)	• Fire breaks.	6.7

Stakeholder	Consultation	Issues Raised	Addressed in EIS
NSW Spatial Services	• Meeting & emails regarding trig stations	• Physical impacts	6.7.2.2
CASA	• Email	• Aviation	6.7.2.1
BoM	• Email	• Weather radar	6.7.2.2

Table 5-4: Consultation undertaken to date with other organisations and stakeholders

Stakeholder	Consultation	Issues Raised	Addressed in EIS
AsA	• Email	• Airspace procedures • Communication with Mudgee Airport Operator	6.7.2.1
TransGrid	• Preliminary connection enquiry June 2018 • Updated connection enquiry Sep 2021	• -	4.1
Mining and exploration licence holders	• Correspondence sent 17 Aug 2021	• Nil	6.10.1.4

5.3.1.4. Other Feedback

During consultation activities, in particular direct correspondence, local information sessions and through the CCC, as well as through online feedback forms, the Project team has received feedback from community members on several issues, as outlined in Table 5-5 below.

Table 5-5 Other community feedback themes

Theme	Feedback
Roads, Modifications and Traffic Management	Interest regarding the transport route, road upgrades required and concerns about dust and traffic management during construction. For analysis see Section 6.6.
Noise	Queries about the audibility of WTGs during operation. A noise contour map was produced and shared with the community. For analysis see Section 6.4.
Landscape and Visual Amenity	Concerns about changes to views. Assessed in Section 6.3.
Aboriginal and Cultural Heritage	Early concerns that areas were adequately assessed and emphasis on the importance of comprehensive assessment. For analysis see Section 6.8.
Property Values	Concerns about whether the proposal may affect the resale value of property.
Community Benefits	Opportunities for broader community benefits and how they might be administered.

5.4. Engagement to be Carried Out

5.4.1. Actions to be Undertaken

As discussed above, the Project has undergone design reviews to incorporate the outcomes of the consultation process. Consultation has contributed to a design that satisfies the avoid-minimise-mitigate hierarchy.

Consultation activities remain ongoing at the time of preparing this EIS and will continue throughout the life of the Project, should it be approved.

Should the Project be approved, prior to the commencement of construction activities, a program of community awareness initiatives will be implemented. Information will be disseminated to the local community through the Project website, local newspapers, and direct mail to advise the community of the nature of pending construction activities, their timing and potential impacts. Contact details will be provided for individuals to gain further information or, if desired, to express concerns or complaints.

Updates on the progress of construction works and relevant impacts will be provided during the construction period.

5.4.2. Ongoing Monitoring and Adaptation of Engagement

The Project team will monitor the performance and effectiveness of communication activities on a regular basis. The team will modify processes and communication channels considering any feedback or issues identified in the monitoring process. Activities to be monitored include the responsiveness and effectiveness of communication with the community and stakeholders as well as information flow throughout the approval process, construction, and operation.

CHAPTER 6

Environmental Assessment

6.1. Environmental Risk Assessment

The Australian New Zealand Risk Management Standard (AS/NZS ISO 31000:2009) defines risk management as "the coordinated activities to direct and control an organisation with regard to risk" (Standards Australia 2009). Risk arises in all aspects of the project life cycle and offers both opportunities and threats and must therefore be managed appropriately.

This EIS adopts an environmental impact assessment methodology aligned to the AS/NZS ISO 31000:2009 standard:

- Potential risks (environmental impacts) have been identified through the Environmental Assessment
- Strategies and actions are identified to mitigate the impact of the risk (Appendix E).
- An assessment is made of the likelihood of the risk occurring and the consequence if the risk were to occur:
    - the likelihood of the risk occurring is described as very unlikely, unlikely, possible, likely, or almost certain to occur; and
    - the consequences or potential impact if the risk event occurred are described as minor, major, severe, critical, or catastrophic.

The risk matrix below (Table 6-1) was used to undertake the environmental risk assessment, and determines a risk rating of low, medium, high, or extreme for each potential impact.

Table 6-1: Environmental risk assessment rating risk

Risk Assessment Matrix		Consequence				
Likelihood		**Minor**	**Major**	**Severe**	**Critical**	**Catastrophic**
		A	**B**	**C**	**D**	**E**
Very Unlikely	**1**	Low	Low	Medium	Medium	Medium
Unlikely	**2**	Low	Low	Medium	Medium	High
Possible	**3**	Low	Medium	High	High	High
Likely	**4**	Medium	Medium	High	High	Extreme
Almost Certain	**5**	Medium	High	High	Extreme	Extreme

An environmental risk assessment has been undertaken for all potential environmental impacts that have been considered within this EIS. The results of this risk analysis are provided in Table 6-2. The unmitigated risk rating is the risk rating prior to detailed assessment, or any mitigation measures being applied and is therefore precautionary and worst-case.

Table 6-2: Environmental risk analysis of adverse environmental issues

Factor	Receptor	Potential Impact	Likelihood	Consequence	Unmitigated Risk
Landscape and Visual	Nearby residences	Reduction in visual amenity due to addition of WTGs within landscape	Likely	Major	Medium
	Adjoining landscape	Reduction in visual amenity due to addition of WTGs within landscape	Likely	Severe	High
Noise and Vibration	Nearby residences	Nuisance noise levels during construction from plant	Likely	Major	Medium
		Nuisance noise levels during operation from WTGs and plant	Likely	Minor	Medium
Biodiversity	Flora species, plant communities and/or habitat	Disturbance/loss of flora species	Almost Certain	Major	High
	Fauna species	Injury and mortality	Possible	Major	Medium
	Terrestrial and aquatic ecosystems	Introduction/spread of weeds	Possible	Minor	Low
		Introduction/spread of pests	Possible	Minor	Low
		Sedimentation and erosion	Unlikely	Minor	Low
		Soil and water pollution	Unlikely	Minor	Low
		Indirect impacts of proposal e.g. light, noise, dust	Unlikely	Minor	Low
Traffic and Transport	Existing road network	Increase in traffic volumes	Possible	Minor	Low
		Increased traffic risks and/or reduced safety	Possible	Major	Medium
Hazards / Risk	Aviation activities	Aviation safety	Unlikely	Severe	Medium
	Telecommunication distributors	Effects on telecommunication systems	Unlikely	Severe	Medium
	Project Site and nearby residences	Health issues relating to electromagnetic fields	Very Unlikely	Major	Low
		Health issues relating to low frequency noise and infrasound	Unlikely	Minor	Low

Factor	Receptor	Potential Impact	Likelihood	Consequence	Unmitigated Risk
		Health issues relating to shadow flicker and blade glint	Unlikely	Minor	Low
		Fire or other hazard caused by lithium-ion batteries from the Battery Storage	Very Unlikely	Critical	Medium
		Bushfire and electrical fire	Unlikely	Critical	Medium
		Blade throw	Very Unlikely	Critical	Medium
Heritage	Aboriginal heritage	Impacts on known artefacts/values	Likely	Minor	Medium
		Impacts on unknown artefacts/values	Possible	Major	Medium
	Historic heritage	Impacts on known artefacts/values	Unlikely	Minor	Low
		Impacts on unknown artefacts/values	Unlikely	Major	Low
Water and Soils	Surface water	Degradation of water quality	Unlikely	Minor	Low
	Project Site	Disturbance and erosion of soils and productive topsoil	Possible	Minor	Low
		Soil compaction leading to concentrated runoff and erosion	Possible	Minor	Low
		Soil contamination due to spills	Unlikely	Minor	Low
		Introduction/spread of weeds	Possible	Minor	Low
	Nearby properties	Reduced agricultural viability	Unlikely	Major	Low
		Dust deposition	Unlikely	Minor	Low
		Reduction in water quantity	Very Unlikely	Minor	Low
		Flooding	Very Unlikely	Minor	Low
	Groundwater	Degradation of water quality	Very Unlikely	Minor	Low
		Reduction in water quantity	Very Unlikely	Minor	Low
	Aquatic Ecosystems	Direct Impacts	Unlikely	Minor	Low
		Indirect Impacts	Unlikely	Minor	Low
Waste	Project site and adjoining areas	Contamination of land and water	Very Unlikely	Minor	Low
		Resource wastage	Unlikely	Minor	Low
		Human and environmental health	Unlikely	Major	Low
Social and Economic	Social	Safety	Unlikely	Critical	Medium
		Health	Unlikely	Minor	Low
		Water Consumption	Possible	Minor	Low
	Economic	Decreased Land Value	Very Unlikely	Major	Low

6.2. Assessment Methodology

The **Environmental Assessment** has been undertaken to assess potential environmental impacts for a range of specific issues identified within the SEARs, the environmental risk assessment and site investigations. The environmental issues addressed within the environmental assessment are shown in Table 6-3.

Table 6-3: Environmental issues addressed within the EIS

Issues	Section of Environmental Assessment
Landscape and Visual	6.3
Noise and Vibration	6.4
Biodiversity	6.5
Traffic and Transport	6.6
Hazards and Risks	6.7
Aboriginal Heritage	6.8
Historic Heritage	6.9
Soils, Land Use and Agricultural Land	6.10
Surface Water, Groundwater, and Aquatic Ecosystems	6.11
Resource Requirements and Waste	6.12
Social	6.13
Economic	6.14
Cumulative Impacts	6.15

A description of ***existing conditions*** is provided for each issue, considering existing levels of development, as well as antecedent conditions as relevant. This provides an opportunity to consider both environmental state and function in the absence of the Project. In accordance with the requirements of the SEARs, all ***potential impacts*** associated with the Project are considered across the entire lifespan of the development, considering construction, operational and decommissioning phases. Potential impacts are considered in addition to existing environmental conditions, representing potential cumulative impacts. Furthermore, where known future development is proposed, consideration is given to potential cumulative impacts as relevant. ***Mitigation measures*** are proposed to effectively manage all potential environmental impacts. These may include design considerations, monitoring strategies, construction safeguards, consultation, training and awareness programs, modified work practices, management plans or other relevant management strategies. A full list of mitigation and environmental management strategies and commitments is provided in **Environmental Management** (Appendix E).

The **Project Justification** (Section 7) provides triple-bottom-line (environmental/social/economic) evaluation of the Project to fully describe the potential benefits and impacts to the environment and the local, regional and NSW community. Potential **residual environmental risks** following mitigation are investigated using likelihood/consequence analysis to describe the potential magnitude of residual impacts. Where the mitigated impact remains high or extreme, further justification is provided to contextualise project risks going forward. Justification against high level social and economic expectations is then considered against the principles of **ESD**, and more specifically, considering the **socio-economic** attributes associated with the Proposed Development. Finally, **potential alternatives** are considered to ensure that approval of the Project is not detrimental when assessed against potential alternative land uses or development. The **Conclusion** (Section 7) integrates the relevant **Statutory and Planning Framework** (Section 4) and commitments made through the **Stakeholder and Community Consultation** process (Section 5) with the findings of the **Environmental Assessment** (Section 6) to provide a concise statement regarding the suitability of the Project and outlines any key points for consideration as part of the development approval process.

6.3

Landscape & Visual

A Landscape and Visual Impact Assessment (LVIA) has been prepared by MLA (2023; Appendix F) in accordance with the requirements of the SEARs, which include:

- *A detailed assessment of the visual impacts of all components of the project (including turbines, transmission lines, substations, and any other ancillary infrastructure in accordance with the NSW Wind Energy: Visual Assessment Bulletin (DPE, 2016), including detailed consideration of potential visual impacts on local residences (including approved developments, lodged development applications and dwelling entitlements), amenity values of the recreation areas surrounding Lake Burrendong, scenic or significant vistas and road corridors in the public domain, and on the Siding Spring Observatory in accordance with the Dark Sky Planning Guideline (2016).*

Assessment Overview

The LVIA was undertaken in accordance with the Visual Bulletin (DPE, 2016b), and assessed the potential impact of WTGs and other Project infrastructure on non-associated landowners as well as the broader visual environment. The assessment identified 20 non-associated dwellings within 4,950 m of the nearest WTG. Of these, 4 were identified within 3,350 m (the Black Line) and 16 were identified within 4,000 – 5,900 m (the Blue Line).

The visual impact rating for non-associated dwellings was largely rated as negligible, very low or low, accounting for 16 of the 20 dwellings. Two (2) non-associated dwellings were assessed as having the potential to have a moderate visual impact and Two (2) may experience a high visual impact. Mitigation measures have been proposed for each of the four (4) non-associated dwellings that were rated as having a moderate or high visual impact, as well as for overall visual amenity.

The Landscape Character Unit assessment determined that the Project is likely to become a feature within the visual landscape. However, due to the undulating topography of the surrounding Project Site, there will be limited opportunities to view the project in its entirety. Furthermore, the character of areas valued for their high landscape quality by community members will remain intact.

The effects of shadow flicker and blade glint were also assessed. The impacts of each were determined to be significantly reduced due to a range of factors, including natural screening in the landscape (shadow flicker) and the use of low reflectivity surface treatments on WTG blades (blade glint). On evaluation, the Project is compliant with the performance objectives as per the Visual Bulletin (DPE, 2016b).

Measures to mitigate potential impacts of the Project are summarised in Section 6.3.3.

Note that the tables and maps of non-associated dwellings considered in the LVIA have been updated compared to the those in the earlier Scoping Report (ELA, 2022) based on input provided by Dubbo Regional Council and Mid-Western Regional Council.

6.3.1. Existing Environment

6.3.1.1. Landscape Character of the Region

The Project Site is located approximately 30 km southeast of Wellington and to the east of Lake Burrendong (Figure 1-1), within the South Western Slopes Bioregion. Located at the foothills of the Great Dividing Range, the bioregion also consists of isolated ranges and inland slopes. The topography of the landscape, particularly around the Project Site, is characterised by steep, rocky granite slopes with inland streams, creeks and rivers that are confined to terraced valleys. Lake Burrendong occupies area to the west of the majority of the Project Site and forms a significant landscape character unit. The Macquarie, Meroo and Cudgegong Rivers all feed into Lake Burrendong

The Project is located within both the Dubbo Regional Council LGA and the Mid-Western Regional Council LGA in the NSW state electorate of Dubbo. Small rural villages such as Hargraves, Mumbil, Yarrabin and Yarragal are located within 8 km of the Project Site. These villages have varying public buildings, schools, stores, and some rural dwellings. The popular tourist destination of the town Mudgee is located approximately 35 km east of the Project Site.

Major highways and roads that provide access to the Project Site and other towns are the Mitchell Highway and Castlereagh Highway. They bifurcate further into major roads which includes Burrendong Way, Yarrabin Road and Worlds End Road. These roads play an important role in providing access to some of the private lanes and roads that lead to dwellings in Yarrabin, Worlds End, Yarragal and Mookerawa. Most of these lanes and private roads are situated on steep slopes with very limited accessibility and provide access to dwellings and include:

- Yarrabin Road
- Worlds End Road
- Wallawaugh Road
- Black Willow Road
- Bonds Road.

6.3.1.2. Landscape Values

During the early stages of the Project, community consultation was undertaken to establish landscape values, key landscape features, important viewpoints, and the community's perception of the Project. A Community Survey of Landscape Values was undertaken to assist in identification of key landscape values. Community consultation was undertaken with the aim of gaining an understanding of the community's concerns. Landscape values are highly subjective and can differ depending on location, local context, and attachment to place.

The questionnaire provided to the community aimed to gain an understanding of the values associated with the landscape as well community concerns and the level of acceptance towards renewable energy. The results of the questionnaire indicated that the most highly valued aspect of the local area held by the community is community and people. Farming and Agriculture, Landforms and terrain and bushland area followed as the next three most important values of the local area. Views and Outlooks as well as employment opportunities were rated as having low value to the community.

Key findings of the questionnaire are shown below in Figure 6-1, Figure 6-2 and Figure 6-3, outlining community feelings regarding renewable energy, perceived visual impacts and community landscape values, respectively.

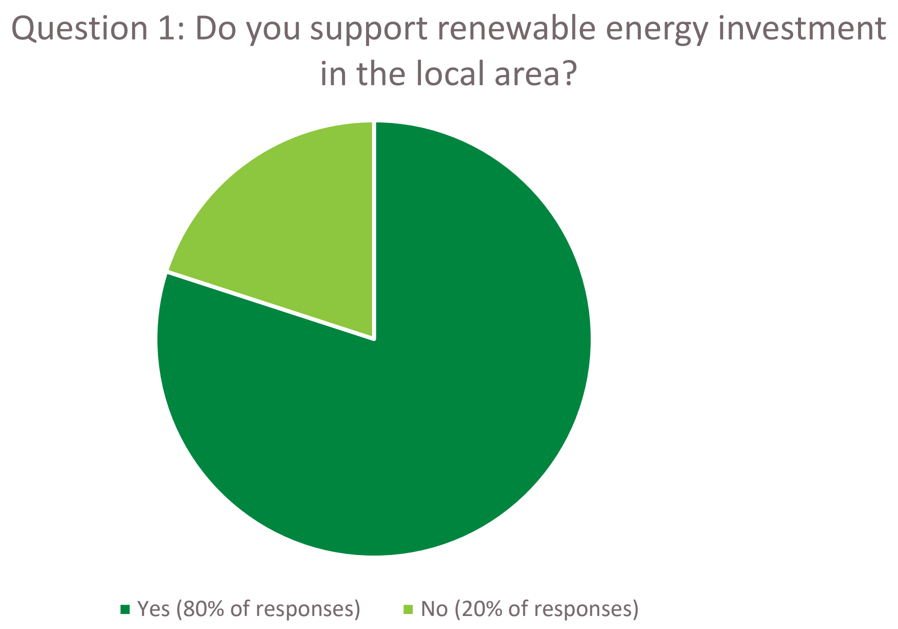


Figure 6-1: Community responses to LVIA community consultation of renewable energy (MLA, 2023)

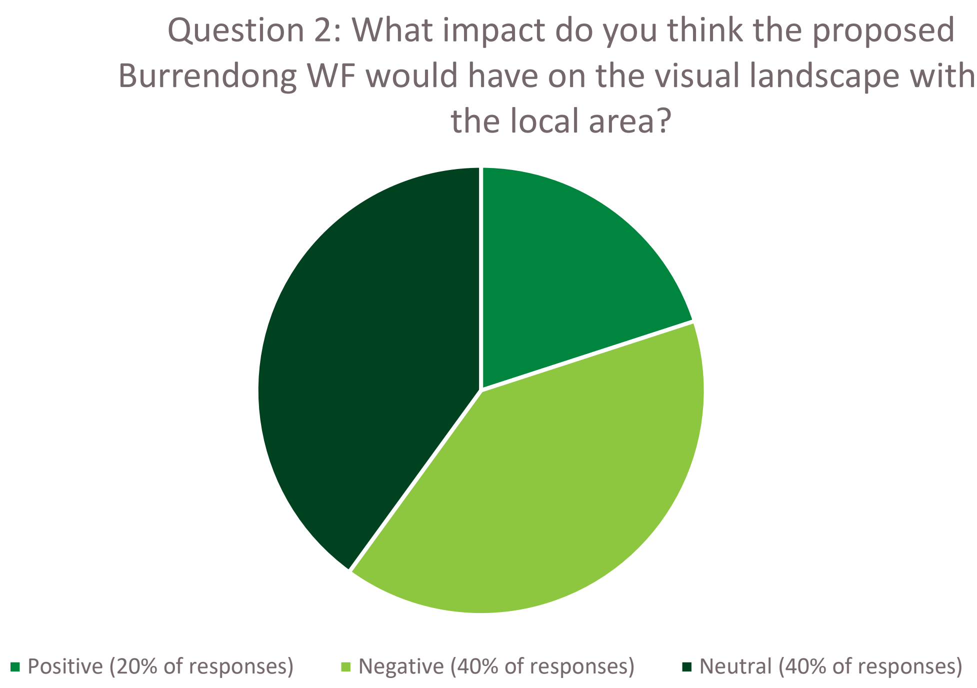


Figure 6-2: Community responses to proposed impact of the Project on visual landscape (MLA, 2023)

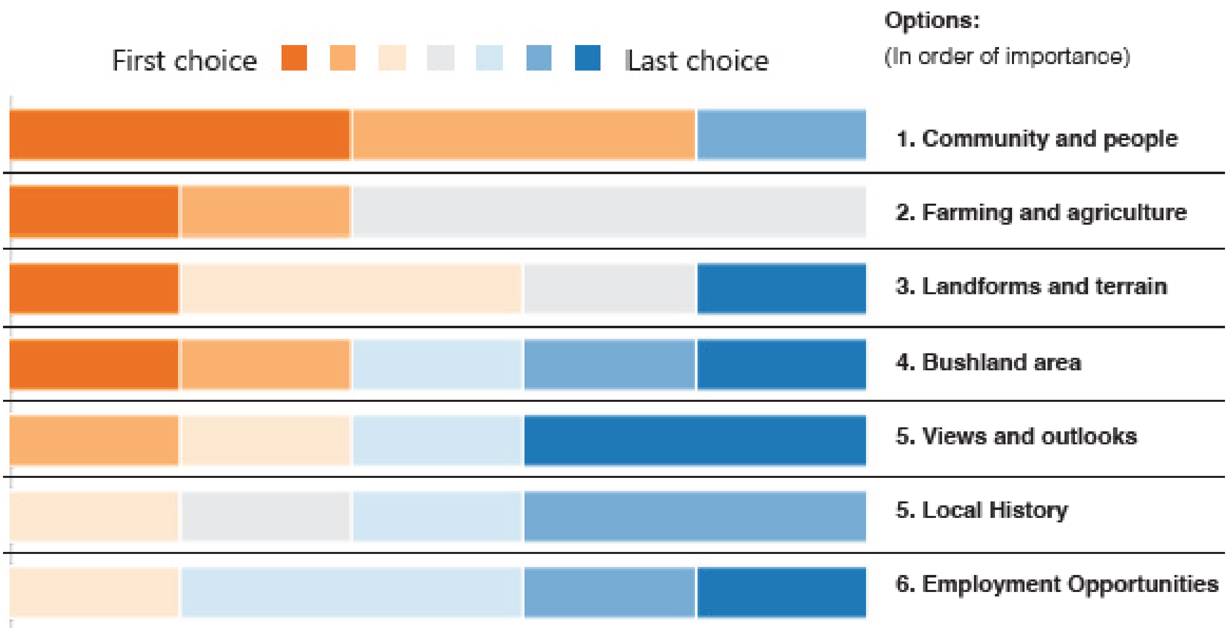


Figure 6-3: Community responses to landscape values (MLA, 2023)

6.3.1.3. Scenic Quality Class Rating

Table 6-4 summarises the Scenic Quality Class Ratings as determined by MLA (2023; Appendix F) across seven Landscape Character Units (LCU). These are also depicted in Figure 6-4.

Table 6-4: Overview of LCUs within the Study Area (MLA, 2023)

Landscape Character Unit	Overview	Scenic Quality Rating
LCU01 Yarrabin / Hargrave Hills	This LCU is defined by steep ridgelines with vegetated hill slopes that span across the Study Area associated with Yarrabin and Hargraves. The Project Site is located within this LCU.	Moderate
LCU02 Yarrabin / Hargrave Farmlands	Yarrabin / Hargrave Farmlands are characterised by gently undulating landscapes that have been cleared for grazing pastures and other agricultural activity.	Low - Moderate
LCU03 Lake Burrendong	Lake Burrendong LCU is defined as the waterway and foreshore associated with Lake Burrendong	Moderate
LCU04 Cudgegong River Valley	Cudgegong River Valley includes the Cudgegong River and associated valley, typically to the north of Lake Burrendong	Moderate
LCU05 Yarragal / Twelve Mile	Yarragal / Twelve Mile is generally defined as the largely uninhabited hills to the north of the Project Site associated with Yarragal and Twelve Mile. Land in this area is associated within the visual catchment of the approved Uungula Wind Farm Project	Moderate
LCU06 Mumbil	Typically the vegetated hills to the west of Lake Burrendong. This land is largely uninhabited except for the small settlement at Mumbil	Low
LCU07 Worlds End	Worlds End is a small LCU defined by the valley known as Worlds End. The land is typically characterised by a valley floor with dwellings utilised as weekenders.	Moderate

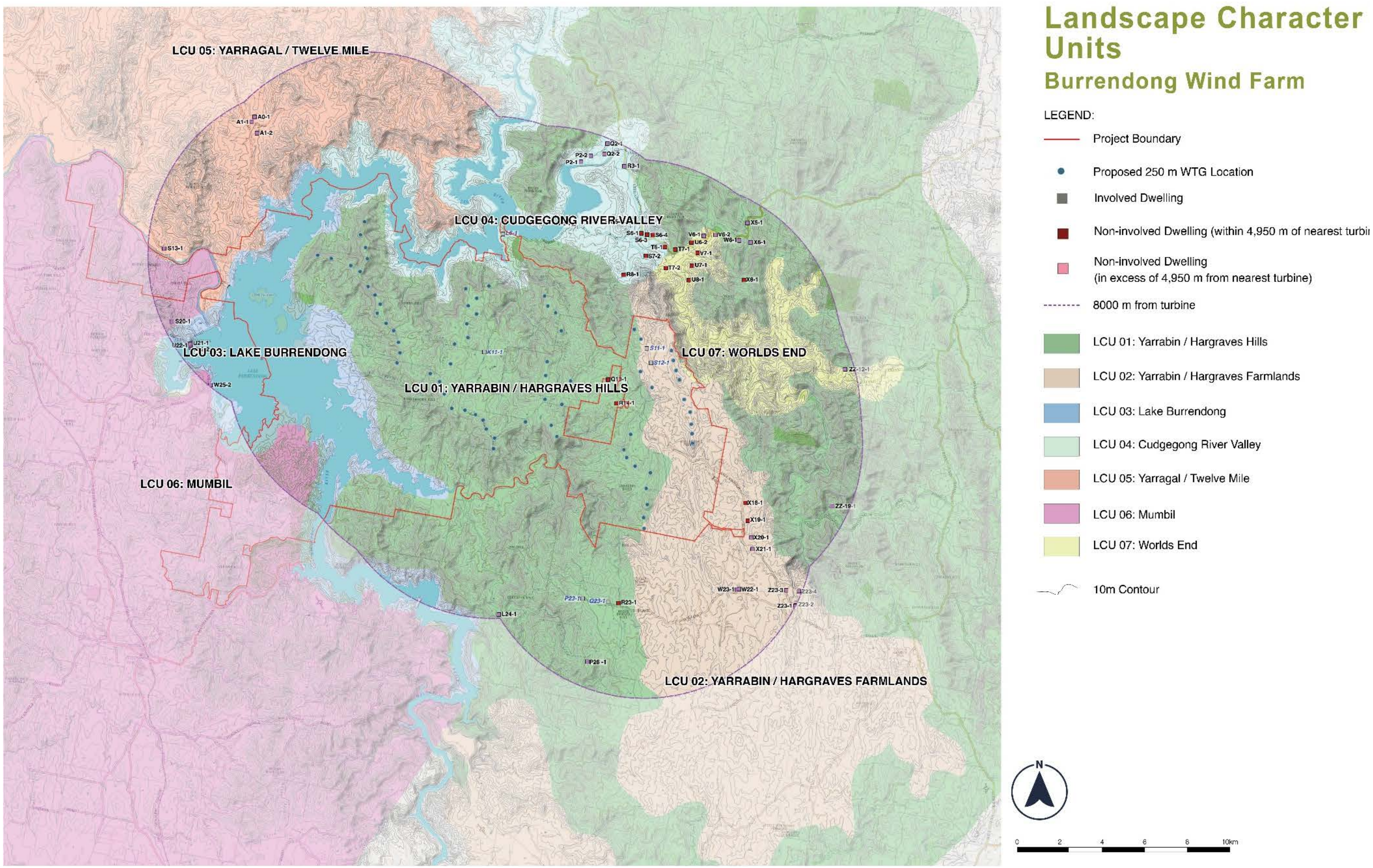


Figure 6-4: LCUs within the Project Site (MLA, 2023)

6.3.2. Potential Impacts

6.3.2.1. Non-Associated Dwellings

A Visual Magnitude assessment was undertaken by MLA (2023; Appendix F) to identify the areas of land from which the Project may be partially or completely visible in the landscape. The assessment was based on the blade tip height of each WTG (being up to 250 m). The Visual Magnitude thresholds used in the assessment are based on a 2D assessment of the Project alone. Further assessment within the report indicates factors such as topography, relative distance and existing vegetation may minimise or eliminate the impacts of the Project from residences.

Four (4) non-associated dwellings are located within 3,350 m of a proposed WTG (otherwise referred to as the 'Black Line' in accordance with the Visual Bulletin (DPE, 2016b. Sixteen (16) non-associated dwellings are located within 3,350 – 4,950 m (otherwise referred to as the 'Blue Line') (Figure 6-5). In accordance with the Visual Bulletin (DPE, 2016b), non-associated dwellings that are located within 4,950 m (Blue Line) of a WTG were categorised into two Visual Influence Zones (VIZ), based on the level of visual significance, with VIZ1 having the most significant impacts to receivers.

VISUAL INFLUENCE ZONE ONE

Two (2) non-associated dwellings were determined as VIZ1 and high impact (R14-1 and Q13-1) due to their proximity to WTGs (Figure 6-5). The Zone of Visual Influence (ZVI) is determined through a combination of the Visibility Distance Zone, Viewer Sensitivity Level and Scenic Quality Class. In accordance with the Visual Performance Objectives of the Visual Bulletin (DPE, 2016b), the performance objective of dwellings within the 'blue line' is to *'avoid turbines or provide detailed justification of turbines below the blue line'*. Screen planting has been proposed for both these dwellings, which once established, is anticipated to reduce the residual impacts to an acceptable level.

VISUAL INFLUENCE ZONE TWO

Seventeen (17) non-associated dwellings were determined as VIZ2 (Figure 6-5). The visual performance objectives for a VIZ2 receptor state to '*manage impacts as far as practicable, justify residual impacts, and describe proposed mitigation measures below the black line*'. The visual impact rating was assessed as negligible, very low or low for 15 of these dwellings and moderate for 2 dwellings (U7-1 and X8-1) (Table 6-5). Screen planting has been proposed for both these dwellings, which once established, is anticipated to reduce the residual impacts to an acceptable level.

Table 6-5: Summary of ZVI assessment for each non-associated dwelling (MLA, 2023)

LCU	Dwelling ID	Distance to Nearest WTG (km)	VIZ	Visual Impact Rating	Reasoning	Mitigation Measures
LCU01 Yarrabin / Hargrave Hills	Q13-1	1.58 km	1	High	Up to 14 WTGs within 3,350 m (Black Line). However, due to vegetation most of these WTGs will be screened. The Project will be theoretically visible in up to 5 60-degree sectors. However, intervening vegetation is likely to reduce the number of visible WTGs to 1 60-degree sector.	Screen planting close to the eastern side of the dwelling.
	R14-1	1.61 km	1	High	Up to 14 WTGs within 3,350 m (Black Line). The Project will be theoretically visible in up to 5 60-degree sectors. However, intervening vegetation is likely to reduce the number of visible WTGs to 1 60-degree sector.	Screen planting to the northern side of the dwelling.
LCU02 Yarrabin / Hargraves Farmlands	R23-1	3.70 km	2	Low	No WTGs are within 3,350 m (Black Line). The Project will be visible in up to 1 60-degree sector. However, vegetation will fragment views.	No mitigation measures are required.
	X18-1	3.76 km	2	Nil	No WTGs are within 3,350 m (Black Line). Eight (8) WTGs are within 4,950 m (Blue Line). However, will be screened by vegetation. The Project will be theoretically visible in up to 2 60-degree sectors. However, will be screened by vegetation.	No mitigation measures are required.
	T6-1	4.13 km	2	Low	No WTGs are within 3,350 m (Black Line). Three (3) WTGs are within 4,950 m (Blue Line). The Project will be theoretically visible in up to 2 60-degree sectors. However, will be screened by topography.	No mitigation measures are required.
	T7-1	4.23 km	2	Low	No WTGs are within 3,350 m (Black Line). Five (5) WTGs are within 4,950 m (Blue Line). The Project will be theoretically visible in up to 2 60-degree sectors.	No mitigation measures are required.
	V7-1	4.67 km	2	Nil	No WTGs are within 3,350 m (Black Line). Three (3) WTGs are within 4,950 m (Blue Line). The Project will be visible in up to 1 60-degree sector.	No mitigation measures are required.
	U6-2	4.75 km	2	Low	No WTGs are within 3,350 m (Black Line). One (1) WTG is located within 4,950 m (Blue Line). The Project will be visible in up to 1 60-degree sector.	No mitigation measures are required.
LCU04 Cudgegong	P5-1	3.67 km	2	Nil	No WTGs are within 3,350 m (Black Line). The Project will be visible in less than 1 60-degree sector.	No mitigation measures are required.

LCU	Dwelling ID	Distance to Nearest WTG (km)	VIZ	Visual Impact Rating	Reasoning	Mitigation Measures
River Valley	S6-3	4.50 km	2	Low	No WTGs are within 3,350 m (Black Line). Two (2) WTGs are within 4,950 m (Blue Line). The Project will be visible in up to 2 60-degree sectors.	No mitigation measures are required.
	S6-4	4.52 km	2	Low	No WTGs are within 3,350 m (Black Line). Two (2) WTGs are within 4,950 m (Blue Line). The Project will be visible in up to 2 60-degree sectors.	No mitigation measures are required.
	S6-1	4.10 km	2	Low	No WTGs are within 3,350 m (Black Line). Four (4) WTGs are within 4,950 m (Blue Line). The Project will be visible in up to 2 60-degree sectors.	No mitigation measures are required.
	Q5-1	4.56 km	2	Low	No WTGs are within 3,350 m (Black Line). Three (3) WTGs are within 4,950 m (Blue Line). The Project will be visible in up to 2 60-degree sectors.	No mitigation measures are required.
LCU07 Worlds End	R8-1	2.61 km	2	Very Low	Up to 2 WTGs within 3,350 m (Black Line), however, due to vegetation only 3 are visible at hub height. The Project will be theoretically visible in up to 2 60-degree sectors. However, topography is likely to reduce the number of visible WTGs to 1 60-degree sector.	No mitigation measures are required.
	T7-2	3.25 km	2	Very Low	Up to 5 WTG within 3,350 m (Black Line), however only one will be partially visible. The Project will be theoretically visible in up to 2 60-degree sectors. However, WTGs will be visible in less than 1 60-degree sector.	No mitigation measures are required.
	U8-1	3.41 km	2	Low	No WTGs are within 3,350 m (Black Line). The Project will be visible in less than 1 60-degree sector.	No mitigation measures are required.
	S7-2	3.50	2	Nil[4]	No WTGs are within 3,350 m (Black Line). The Project will be visible in less than 1 60-degree sector.	No mitigation measures are required.
	U7-1	3.39	2	Moderate	No WTGs are within 3,350 m (Black Line). Four (4) WTGs are within 4,950 m (Blue Line). However, will be screened by vegetation. The Project will be theoretically visible in up to 2 60-degree sector.	Screen planting to the southwest of the dwelling.

[4] Note: *No access to the site was available. The wire frame diagram is a preliminary assessment tool that represents a bare ground scenario – i.e. a landscape without screening, structures or vegetation. As accurate information to the height and coverage of vegetation and buildings is unavailable, it is important to note the wire frame diagram is based solely on topographic information. Therefore, this should be acknowledged as representing the absolute worst case scenario.*

LCU	Dwelling ID	Distance to Nearest WTG (km)	VIZ	Visual Impact Rating	Reasoning	Mitigation Measures
	X19-1	4.48 km	2	Nil	No WTGs are within 3,350 m (Black Line). Five (5) WTGs are within 4,950 m (Blue Line). However, will be screened by vegetation. The Project will be theoretically visible in up to 2 60-degree sectors.	No mitigation measures are required.
	X8-1	4.76	2	Moderate	No WTGs are within 3,350 m (Black Line). One (1) WTG is within 4,950 m (Blue Line). The Project will be visible in up to 1 60-degree sector.	Screen planting to the west of the dwelling.

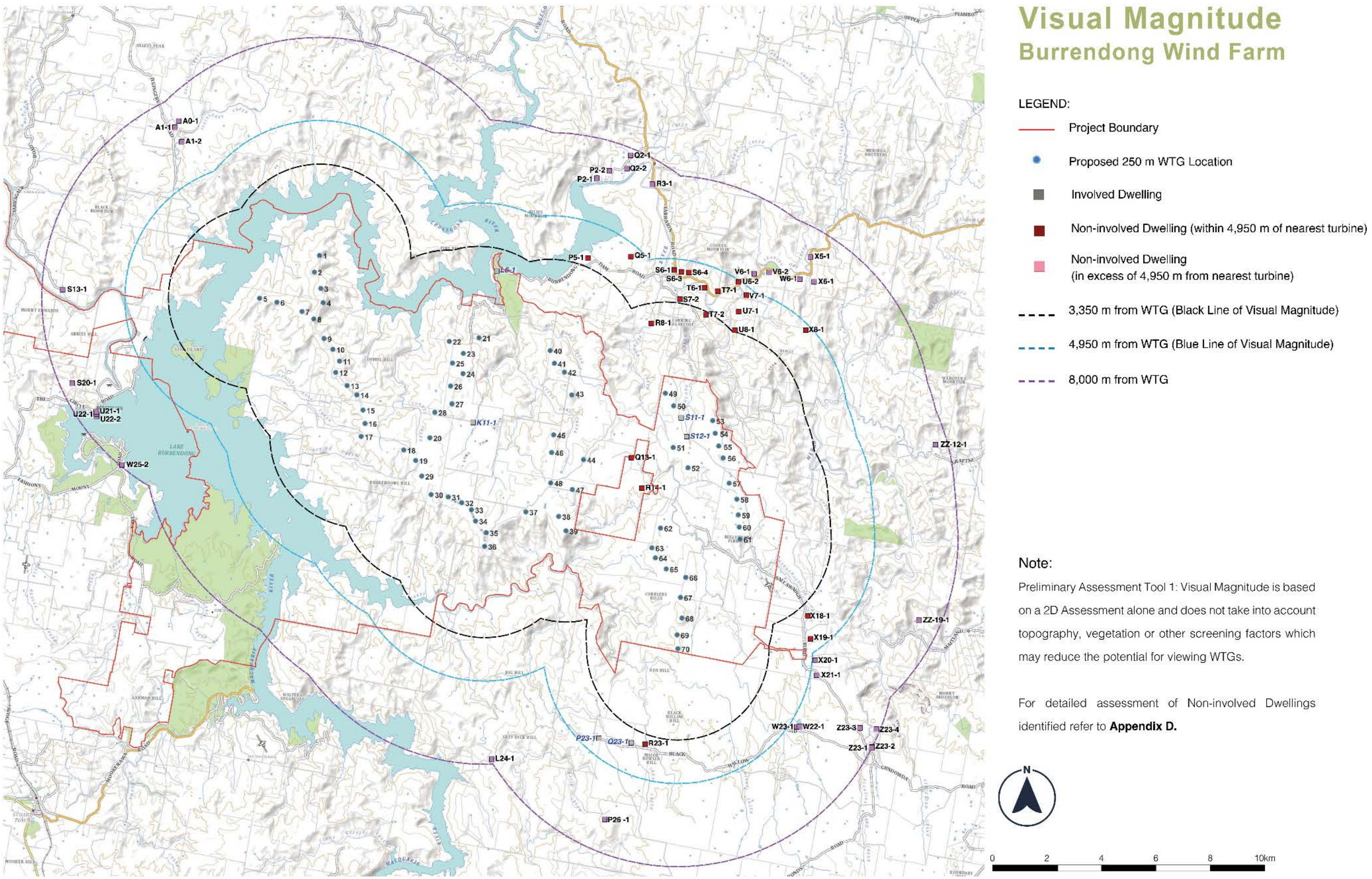


Figure 6-5: Non-associated dwellings located within the Black and Blue Lines of Visual Magnitude (MLA, 2023)

6.3.2.2. Visual Amenity of the Existing Landscape, Key Public Viewpoints and LCUs

EXISTING LANDSCAPE

Two (2) ZVI diagrams were prepared to illustrate the theoretical visibility of the Project within and across the landscape. The diagrams are based on both the visibility of the WTG blade tip height of 250 m (Figure 6-6) and a WTG hub height of 160 m (Figure 6-7). Areas that have been identified as having potential to view the Project in its entirety are generally isolated, and it is likely intervening vegetation would reduce the potential to view all the WTGs.

No non-associated dwellings have the potential to view the Project in its entirety. The most densely populated area is located to the northeast of the Project associated with Yarrabin Road and the Meroo River. The ZVI indicates views of the Project from dwellings in this area are limited to between WTGs 1 – 24. The ZVI indicates that views to the Project are limited from areas more than 8 km due to topography.

KEY PUBLIC VIEWPOINTS

A public viewpoint analysis was undertaken to determine the likely impact of the Project on existing landscape features and visual characteristics. A total of 24 viewpoints (Figure 6-8), were taken from public locations and were selected to be representative of the range of views within the Project Site, including:

- Viewpoints identified by the community in the preliminary community consultation phase of the Scoping Report
- Present landscape character types
- Areas of potentially high landscape or scenic value
- Range of distances
- Varying aspects and elevations
- Varying extent of wind farm visibility (full and partial visibility)
- Sequential views along specific routes.

Potential visual impacts at each viewpoint are summarised in Table 6-6. An evaluation of impacts at each viewpoint was undertaken using the performance objectives set out within the Visual Bulletin (DPE, 2016b).

VISUAL INFLUENCE ZONE ONE

There are no publicly accessible viewpoints identified as VIZ1 (Table 6-6; Figure 6-8).

VISUAL INFLUENCE ZONE TWO

One (1) viewpoint was rated as VIZ2 (Table 6-6; Figure 6-8). This viewpoint was taken from Cudgegong River Park (BWF09) and was rated as VIZ2 due to the moderate viewer sensitivity (Level 2) and proximity to the Project (3.04 km). The viewpoint location was assessed against the performance objectives outlined in the Visual Bulletin (DPE, 2016b). It was assessed that the Project was likely to be visible from each of the viewpoints, however the visual performance objectives were met for each viewpoint.

VISUAL INFLUENCE ZONE THREE

Twenty-three (23) viewpoints were rated as VIZ3 (Table 6-6; Figure 6-8). This is generally due to the low landscape sensitivity and/or distance to the Project. There are no performance objectives for VIZ3 receptors.

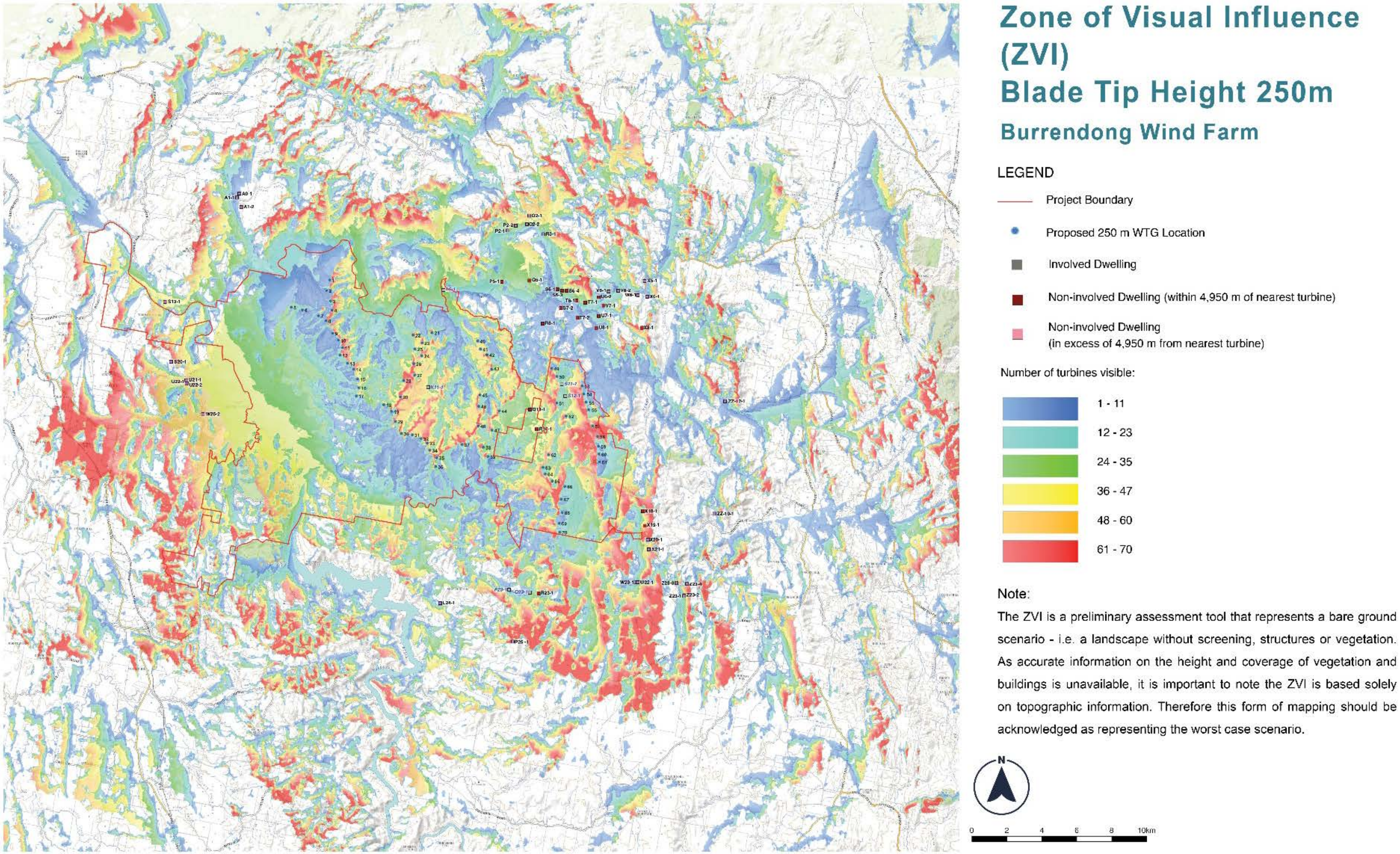


Figure 6-6: Zone of Visual Influence - Blade Tip height (250 m) (MLA, 2023)

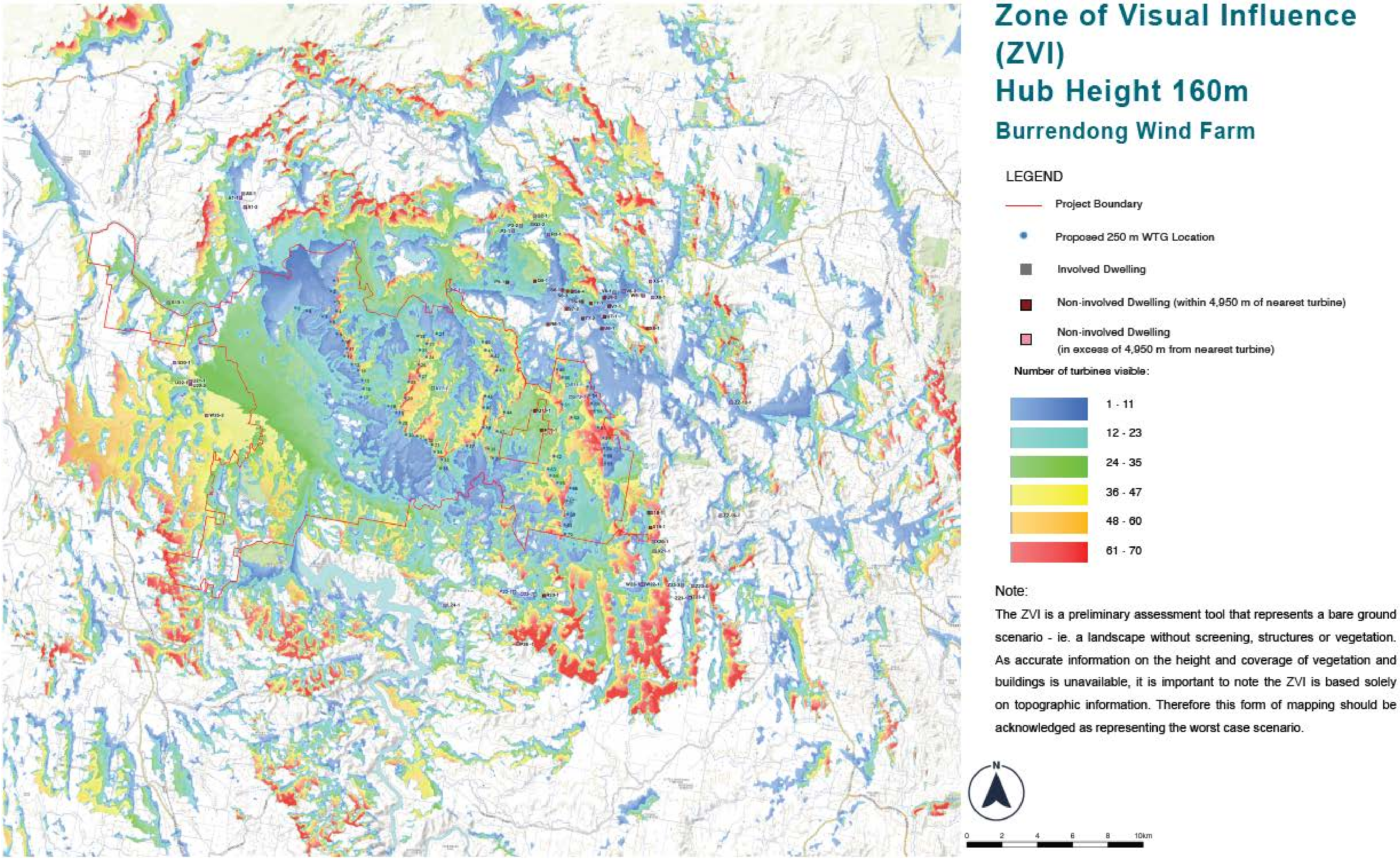


Figure 6-7: Zone of Visual Influence - Hub Height (160 m) (MLA, 2023)

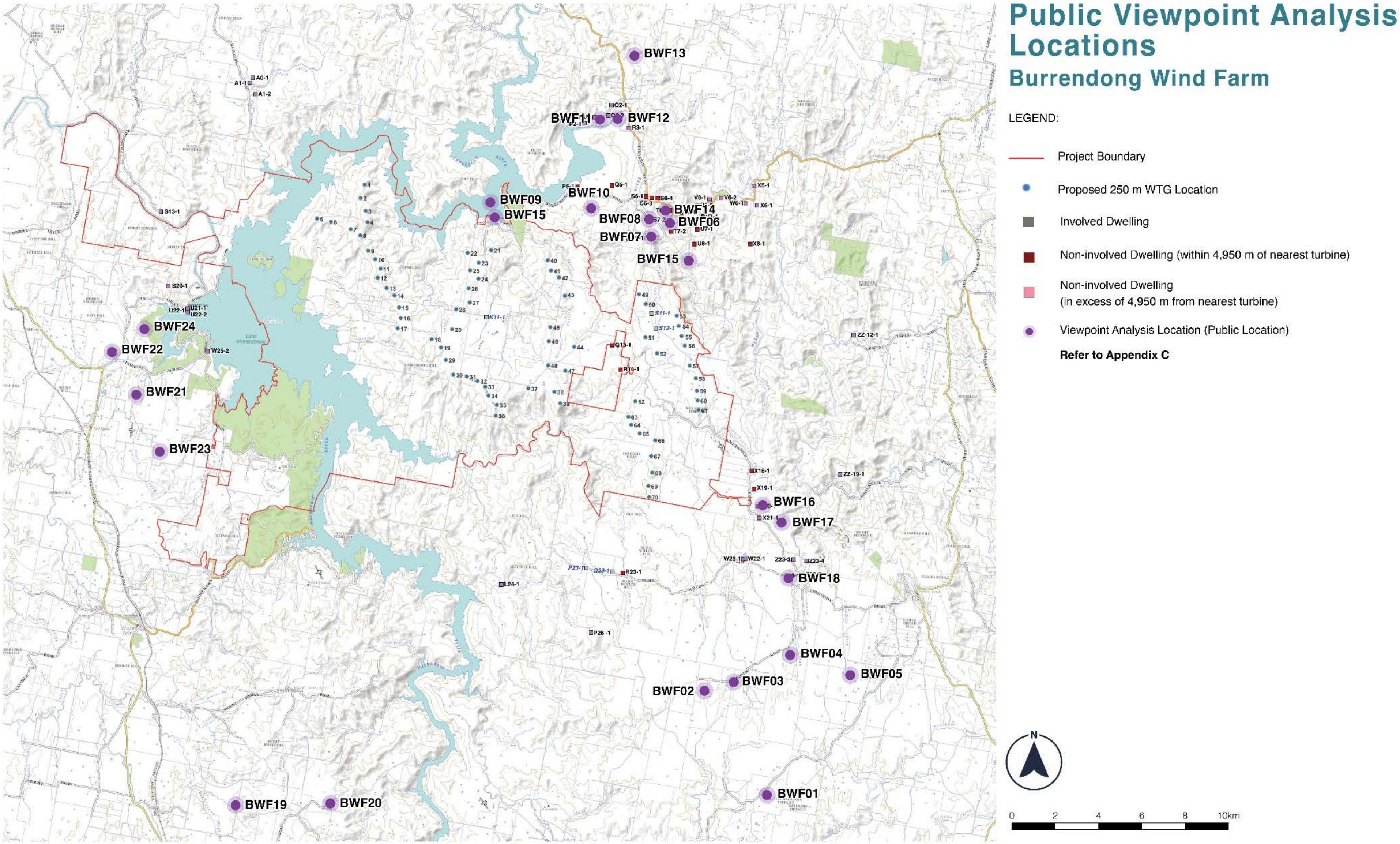


Figure 6-8: Location of public viewpoints (MLA, 2023)

Table 6-6: Public viewpoint analysis results (MLA, 2023)

Viewpoint	VIZ	LCU	Description	Potential Visual Impact	Assessment against Visual Performance Objectives
BWF01	3	LCU02	View from Bonds Road, approximately 9 km south of the Project Site, which provides access to several isolated rural dwellings. Land in this area is largely cleared for grazing and slightly undulating. Views extend to the vegetated hills to the north.	Views to the Project to the north of the viewpoint, more than 9 km to the north of this viewpoint. Existing vegetation is likely to fragment views to the WTGs.	N/A
BWF02	3	LCU02	View from a cleared section of Black Willow Road, approximately 4.6 km east of the nearest WTG. Black Willow Road is an unsealed minor road providing access to isolated rural dwellings. The undulating land in this area is a combination of vegetated hills with foothills that have been cleared for grazing.	From this location, it is likely views to the nearest WTG will be screened by vegetation to the west. The nearest visible WTG will be approximately 4.6 km to the north-north-west of this viewpoint.	N/A
BWF03	3	LCU02	View from Black Willow Road, looking in a generally northwest direction. Land is slightly undulating, sloping towards Smiths Creek to the west. Land is cleared for grazing with dense vegetation containing views to the north and northeast.	From this viewpoint, it is likely that views to the tips of WTGs will be available to the northwest. Vegetation in the foreground is likely to fragment views.	N/A
BWF04	3	LCU02	View from Black Willow Road, approximately 3 km northwest of the intersection with Wallawaugh Road. Land in this area is undulating and predominately cleared, with some scattered remnant vegetation and dense vegetation visible on the ridge to the northwest.	From this location, views to the Project will be available more than 5 km, beyond the vegetated hills to the northwest. Existing vegetation in the middle ground is likely to fragment views to some WTGs associated with the Project.	N/A
BWF05	3	LCU02	View from Gundowda Road, near the intersection of Wallawaugh Road and Black Willow Road. Land slopes to the south to Scabbing Yard Creek. Views are contained by the vegetated ridge to the west.	Based on an assessment of topography, it is determined that no WTGs will be visible from this viewpoint location.	N/A
BWF06	3	LCU04	View from the intersection of Yarrabin / Burrendong Dam Road and Kangaroo Grounds Road. Land is characterised by cleared grazing land with vegetated hills. Vegetation associated with the Meroo River is visible in the foreground.	Based on an assessment of topography alone, it is likely small extents of the Project will be visible in 4 locations along the ridgeline, generally between the south and west. Views will be fragmented in some locations by existing vegetation in the foreground.	N/A

Viewpoint	VIZ	LCU	Description	Potential Visual Impact	Assessment against Visual Performance Objectives
BWF07	3	LCU04	Viewpoint was taken approximately 90 m to the west of dwelling S7-1, located off Worlds End Road. This unsealed road is a minor road which provides access to S7-1 and R8-1 (located approximately 1.2 km south of this point). Land in this area is characterised by cleared grazing land surrounded by steep, vegetated ranges. Views to the south are contained by the steep hills. Vegetation associated with Redbank Creek is visible in the foreground.	Based on an assessment of topography alone, it is likely small a total of 4 blade tips would be visible beyond the ridgeline to the south. It is anticipated the tips would be difficult to discern, due to fragmentation by vegetation and distance.	N/A
BWF08	3	LCU04	Viewpoint was taken at the entry to Worlds End Road, off Burrendong Dam Road. Land in this area is typical of the Meroo River Valley LCU, with land cleared on the flats and vegetation on the surrounding hills. Worlds End Road is a minor road which provides access to several small cottages / weekenders.	Based on an assessment of topography alone, it is likely up to 4 WTGs and 4 blade tips will be visible from this location. Scattered vegetation in the middle ground is likely to fragment views to WTGs to the south-south-west of this location.	N/A
BWF09	2	LCU04	Viewpoint was taken from boat ramp access to the Cudgegong River at Cudgegong River Park, located at the end of Burrendong Dam Road. Cudgegong River Park is a large holiday park accommodating long stay and temporary visitors. Land in this area is generally characterised by the large, vegetated hills surrounding the Cudgegong River.	A desktop assessment determined up to 20 WTGs would be visible along the vegetated ridgeline to the south of this location.	VISUAL MAGNITUDE One (1) WTG is located within 3,350 m (Black Line) of the viewpoint. Views from the riverbank will change as viewers move around. Therefore, it would be impracticable to mitigate the visible WTG from this location. MULTIPLE WIND TURBINE TOOL WTGs are located within 1 60-degree sector of the view, which is deemed acceptable. LANDSCAPE SCENIC INTEGRITY WTGs will be apparent and may be a major element in the landscape

Viewpoint	VIZ	LCU	Description	Potential Visual Impact	Assessment against Visual Performance Objectives
					when looking to the south, however they will not dominate the existing visual catchment in this location. KEY FEATURE DISRUPTION The proposed WTGs will be a visible element on the vegetated ridge to the south, however the vegetated ranges and water body will remain the dominant feature of views in this location.
BWF10	3	LCU04	Viewpoint was taken from Burrendong Dam Road, approximately 300 m southeast of dwelling P5-1. Burrendong Dam Road is a minor road which continues to the west to Cudgegong River Park. Land is generally flat with scattered vegetation. Views are contained by the surrounding vegetated ranges.	From this location, views to a small portion of the Project may be available to the south and south-southeast. Views are likely to be fragmented by scattered vegetation in the foreground. Views to WTGs to the south-west are likely to be screened by vegetation.	N/A
BWF11	3	LCU04	Viewpoint was taken from Endacotts Lane, a low use, unsealed road which runs in a generally southwest direction from Yarrabin and provides access to several dwellings. Land is generally flat, associated with the bank of the Meroo River, with surrounding vegetated hills containing views.	From this location, an assessment based on topography alone approximately 20 WTGs and 2 blades would be visible from this location, however vegetation which is typical of the area is likely to fragment views to the WTGs, particularly to the south-south-west.	N/A
BWF12	3	LCU04	Viewpoint was taken from Endacotts Lane, at the driveway to a dwelling. Land is generally flat, associated with the bank of the Meroo River, with surrounding vegetated hills containing views.	Views to the Project from this location will be limited to four (4) WTGs located more than 7.28 km to the south and up to 15 WTGs visible to the southwest (more than 8 km). Scattered vegetation in the foreground is likely to fragment views from some viewing locations.	N/A
BWF13	3	LCU04	View from a clearing along the otherwise vegetated roadside associated with Yarrabin Road. Views from this low use road extend across cleared grazing land to distant vegetated hills.	From this location, views will be available to WTGs associated with the Project to the south and south southwest. Views will be brief and limited to motorists travelling in a south direction.	N/A

Viewpoint	VIZ	LCU	Description	Potential Visual Impact	Assessment against Visual Performance Objectives
			Vegetation associated with the Meroo River is visible in the middleground of the viewpoint.		
BWF14	3	LCU04	View from the driveway entry to Dwelling S6-1 on Yarrabin Road. This viewpoint is located approximately 300 m north of the intersection with Burrendong Dam Road. Dwelling S6-3 is located to the west of this viewpoint. Land is typically flat and cleared except for some scattered vegetation, roadside vegetation and plantings surrounding the dwelling in the foreground.	From this location, views will be available to WTGs associated with the Project to the south and south southwest. Vegetation in the foreground is likely to fragment views to the Project in some locations.	N/A
BWF15	3	LCU07	View from Worlds End Road, near Highland Home Creek. This is the furtherest point of travel along Worlds End Road before a locked gate prevents public access. Land in this area is typical of the Worlds End Landscape Character Unit, defined as the valley floor associated with the eastern extent of the Meroo River. Steep vegetated hills surround the valley floor.	From this location, views will be available to two (2) WTGs to the south. Existing vegetation surrounding dwelling structure in the foreground is likely to reduce visibility, however it is anticipated the tips of WTGs will likely be visible above the vegetation.	N/A
BWF16	3	LCU02	View from Wallawaugh Road, approximately 130 m southeast of the intersection with Highland Home Road. Land in these areas is undulating, with views contained by a rise in topography to the west and steep rise to the northwest associated with Millenbong Pinnacle. Wallerwaugh Homestead is visible in the foreground.	From this location WTGs associated with the Project will be a visible feature in the landscape to the northwest. Views to WTGs to the west are likely to be fragmented by vegetation in the foreground.	N/A
BWF17	3	LCU02	View from Wallawaugh Road, at the entry to 'Waterside' (dwelling ID: X18-2). Land in this area is typical of the undulating farmland landscape character unit. Land is cleared except for scattered remnant vegetation, along the roadside and associated with Warramagullon Creek.	From this location WTGss associated with the Project have the potential to be visible to the northwest above the intervening roadside vegetation. Views to WTGs to the west are likely to be fragmented by vegetation in the foreground.	N/A
BWF18	3	LCU02	View from Wallawaugh Road. Land in this area is characterised by undulating farmland which has been cleared in some areas, however dense vegetation is still evident in some areas.	Wallawaugh Road has remnant roadside vegetation containing views towards the Project for the most part. Views to the Project are unlikely to be available from this location due to the roadside vegetation.	N/A

Viewpoint	VIZ	LCU	Description	Potential Visual Impact	Assessment against Visual Performance Objectives
BWF19	3	N/A	View from Mount Aquila Road looking in a generally northeast direction towards the Project Site. Mount Aquila Road is an unsealed road with a low frequency of use which is utilised to access a small number of isolated dwellings to the east of the Macquarie River. Views along Mount Aquila Road are generally contained by vegetation typical of the surrounding areas, however infrequent openings in the vegetation provide expansive views to the vegetated ranges to the north.	From this viewpoint, it is likely the Project would be visible in its entirety (more than 15 km). Some vegetation in the middle ground is likely to fragment views to the distance WTGs. It is likely the Approved Uungula Wind Farm would be visible beyond the Project.	N/A
BWF20	3	N/A	View from Mount Aquila Road looking in a generally northeast direction towards the Project Site. Mount Aquila Road is an unsealed road with a low frequency of use which is utilised to access a small number of isolated dwellings to the east of the Macquarie River. Views along Mount Aquila Road are generally contained by vegetation typical of the surrounding areas, however infrequent openings in the vegetation provide expansive views to the vegetated ranges to the north.	From this viewpoint, it is likely the Project would be visible in its entirety to the northeast, except for WTGs screened by vegetation in the foreground. WTGs are more than 13 km from this viewpoint.	N/A
BWF21	3	LCU06	This viewpoint was recorded at the Reflections Holiday Park at Fashions Mount Road in Mumbil. Accommodation associated with the holiday park is generally located to the west of this viewpoint and is orientated towards the internal road layout. Views to the east extend across the Lake Burrendong water body to the vegetated ranges to the east.	From this viewpoint, the Project will be visible in the near background (more than 7 km) to the east of Lake Burrendong. The views across the Lake to the vegetated ranges associated with the Project Site will remain the dominant feature of the view from this location.	N/A
BWF22	3	LCU06	View from Mumbil on the Circuit Road, close to the Ridgecrest Christian Education & Convention Centre. Ridgecrest Christian Education and Convention Centre provides accommodation and function space for private use. Views extend across Lake Burrendong to the vegetated hills associated with the Project Site.	From this viewpoint, it is likely the Project would be visible in its entirety to the northeast, except for WTGs screened by vegetation in the foreground.	N/A

Viewpoint	VIZ	LCU	Description	Potential Visual Impact	Assessment against Visual Performance Objectives
BWF23	3	LCU06	View from Burrendong Sport and Recreation Centre, more than 8 km west of the Project. The Sport and Recreation Centre is utilised for school camps, sports camps, and accommodation for large groups.	From this viewpoint, it is likely the Project would be visible in it the break in vegetation to the east. The WTGs are more than 8 km from the viewpoint.	N/A
BWF24	3	LCU03	View from Lake Burrendong Dam wall looking towards the east across Lake Burrendong towards vegetated hills associated with the Project Site.	From this viewpoint, it is likely the Project would be visible to the east more than 6 km from the dam.	N/A

6.3.2.3. Landscape Character Units

Table 6-7 outlines the visual impact for each LCU. Of the 7 LCU's identified and assessed, the Project is likely to be visible from all, to varying degrees. However, due to the undulating topography surrounding the Project Site, there are limited opportunities to view the Project in its entirety.

The Project is to be located within a predominantly rural landscape that has not been identified as significant or rare. The broad landscape character is dominated by established rural land which consists primarily of modified undulating hills.

The Project is likely to become a feature of the area. However, the degree to which the existing landscape character and significance is altered because of the Project is determined by the dominance of the Project in relation to the existing landscape features. It is likely the character of areas which are valued for their high landscape quality and utilised for recreation and tourism will remain intact. Regionally, significant landscape features identified would remain dominant features of the landscape and it is unlikely the Project would degrade the scenic value of these landscape features.

Table 6-7: Overview of the visual impacts for each LCU (MLA, 2023)

LCU	Scenic Quality Rating	Visual Performance Objectives		
		Visual Impact	Landscape Scenic Integrity	Key Landscape Features
LCU01 Yarrabin Hargrave Hills	Moderate	The Yarrabin / Hargraves Hills LCU is generally defined by the vegetated hills associated with Yarrabin and Hargraves. Generally, the hills are uninhabited and largely inaccessible to the public. The Project Site is located within the land defined as the Yarrabin / Hargraves Hills, and therefore views to the Project from within the LCU will be available to varying degrees.	Land in this LCU is generally characterised by steep undulating hills which are largely uninhabited and inaccessible. The hills form a backdrop to views from surrounding areas, for example distant views across Lake Burrendong from Mumbil. As accessibility within the LCU itself is limited, there are limited opportunities to view the Project in its entirety. A handful of elevated properties within the LCU will have expansive views across the Project, however for the most part views	• Vegetated Hills
LCU02 Yarrabin Hargraves Farmlands	Low / Moderate	The Yarrabin / Hargraves Farmlands LCU is generally defined as the predominately cleared and undulating grazing land associated with localities of Yarrabin and Hargraves. Land in this area is accessible by low use roads which provide access to rural residential dwellings. Views to the Project will be available from the LCU to varying degrees, however existing screening factors including roadside vegetation	Land in this LCU is largely characterised by the cleared undulating topography with views to vegetated hills. The Project has the potential to be visible to varying degrees from some locations within the LCU, however the Project is likely to occupy a small portion of the view and it is unlikely to alter the scenic integrity of the LCU.	• Undulating Landscape • Vegetated Hills • Riparian Vegetation • Rivers and Creek lines
LCU03 Lake Burrendong	Moderate	The Lake Burrendong LCU is defined as the water body of Lake Burrendong and surrounding foreshore. The Project Site extends into the LCU. Access to the LCU is generally limited to those using the Lake for recreation purposes (fishing, water skiing etc). The foreshore is largely inaccessible as it is private property. Views of the Project from within the LCU will be available, particularly to those using the Lake	The scenic integrity of the LCU is generally associated with the water body and views to surrounding vegetated hills that form a backdrop to views across the lake. The scenic integrity of the LCU is likely to remain intact. Although the WTGs will be a noticeable element to those using the lake for recreational boating activities, viewers will have views in all directions and the Project will only be visible to portions of the LCU	• Views across Lake Burrendong • Vegetated ranges as a backdrop
LCU04 Cudgegong River Valley	Moderate	The Cudgegong River valley is generally defined as the land to the north of the Project Site associated with the Cudgegong River and surrounding valley. The extent of visibility of the Project varies depending on th viewing	Land in the area is generally characterised by predominantly cleared farmlands surrounded by steep vegetated hills. The scenic integrity of the LCU is	• Cudgegong River • Vegetated hills • Cleared rural landscape

LCU	Scenic Quality Rating	Visual Performance Objectives		
		Visual Impact	Landscape Scenic Integrity	Key Landscape Features
		location within the LCU, however for the most part, views to the Project are limited by topography.	unlikely to be impacted as views to the Project will be limited.	
LCU05 Yarragal Twelve Mile	Moderate	The Yarragal / Twelve Mile LCU is generally defined as the land to the north of the Cudgegong River associated with Yarragal and Twelve Mile LCU. Land in this area is generally uninhabited, except for some isolated dwellings along Ilgingery Road (Yarragal).	The proposed Uungula Wind Farm is located within the LCU to the north of the Project. Potential for cumulative visual impacts from dwellings has been assessed and the assessment determined there are minimal opportunities to view both projects due to topography. The Project is unlikely to alter the scenic integrity of this LCU.	• Undulating topography • Steep hills
LCU06 Mumbil	Low	The Mumbil LCU is generally characterised by the land to the west of Lake Burrendong, associated with the locality of Mumbil. Views from within the LCU are generally contained by the undulating topography. Views to the Project will be available from elevated positions within the LCU and from areas to the west of Lake Burrendong.	Land within the LCU is largely uninhabited except for some dwellings and recreation facilities on the western edge of Lake Burrendong. Views across the Lake to vegetated hills associated with the Project add to the scenic quality of the LCU. The Project is likely to be visible in the distance and although noticeable is unlikely to have a detrimental impact on the scenic integrity of the LCU.	• Views across Lake Burrendong • Vegetated Hills of LCU01 as a backdrop
LCU07 Worlds End	Moderate	The Worlds End LCU is a small area characterised by the valley floor associated with the Meroo River to the east of the Project Site. The LCU has several isolated weekenders and dwellings accessed via a locked gate on Worlds End Road. The Project is likely to be visible to varying degrees to the west of the LCU.	Land within the LCU is generally accessible to landowners with access via a locked gate on Worlds End Road. The LCU is characterised by the valley floor with steep, vegetated hills to the west generally containing views. Dwellings are generally located along the valley floor associated with the Meroo River, with dense riparian vegetation limiting views.	• Steep vegetated hills

6.3.2.4. Shadow Flicker

In accordance with the Visual Bulletin (DPE, 2016b), shadow flicker should be limited to 30 hours per year, and mitigation measures should be implemented to reduce its effects.

Rotating WTGs cause moving shadows as the blades pass through the sun. This visual effect is known as shadow flicker. At times of day, the sun's rays will pass through the blades causing potential impacts on viewpoints. The effect scales with distance of the viewpoint from the WTG. Viewing the shadow from further away will have less of an impact, and the shadow intensity diminishes. Shadow flicker is also influenced by cloud cover and the angle of the sun relative to the blade (EPHC, 2010).

To assess shadow flicker, the *QLD State Code 23: Wind Farm Development* (DSDILGP, 2023) were used. A blade tip height of 250 m was used to model impacts of shadow flicker to represent the worst-case impact scenario. The assessment was based on topography alone, however there are several factors which may decrease the severity of impacts such as screening, time of year, daylight hours and cloud frequency.

A total of 2 non-associated dwellings were identified with potential shadow flicker hours (R14-1 and Q13-1) as shown in Figure 6-9 and Table 6-8. The shadow flicker assessment found both dwellings are likely to experience less than 30 hours per year of shadow flicker.

Table 6-8: involved dwellings with the potential to experience shadow flicker (MLA, 2023)

Dwelling ID	Shadow Hours per year	Shadow Days per year	Max Shadow Hours per year	Assessment notes
R14-1	17:40	38	0:39	Acceptable level
Q13-1	26:16	79	0:32	Acceptable level

Although there are no guidelines in the Visual Bulletin (DPE, 2016b) relating to the acceptable level of shadow flicker on road users, shadow flicker has the potential to cause annoyance to road users. The shadow flicker assessment identified that a small extent of Wallawaugh Road has the potential to experience shadow flicker. As the road has a low frequency of use and extensive roadside vegetation, the potential impact is likely to be negligible.

6.3.2.5. Blade Glint

Blade glint refers to reflectivity of light off the WTG blade components. It involves the regular reflection of the sun off rotating WTG blades and depends on the orientation of the nacelle, angle of the blade and angle of the sun. The effect is often temporary and is most noticeable where the viewer is above the altitude of the WTG hub. While there is a potential for blade glint to occur, modern WTGs are often constructed with low reflectivity surface treatments to reduce the effect of the glint, as required by the Visual Bulletin (DPE, 2016b). This will result in limited potential to impact stakeholders within proximity to the Project.

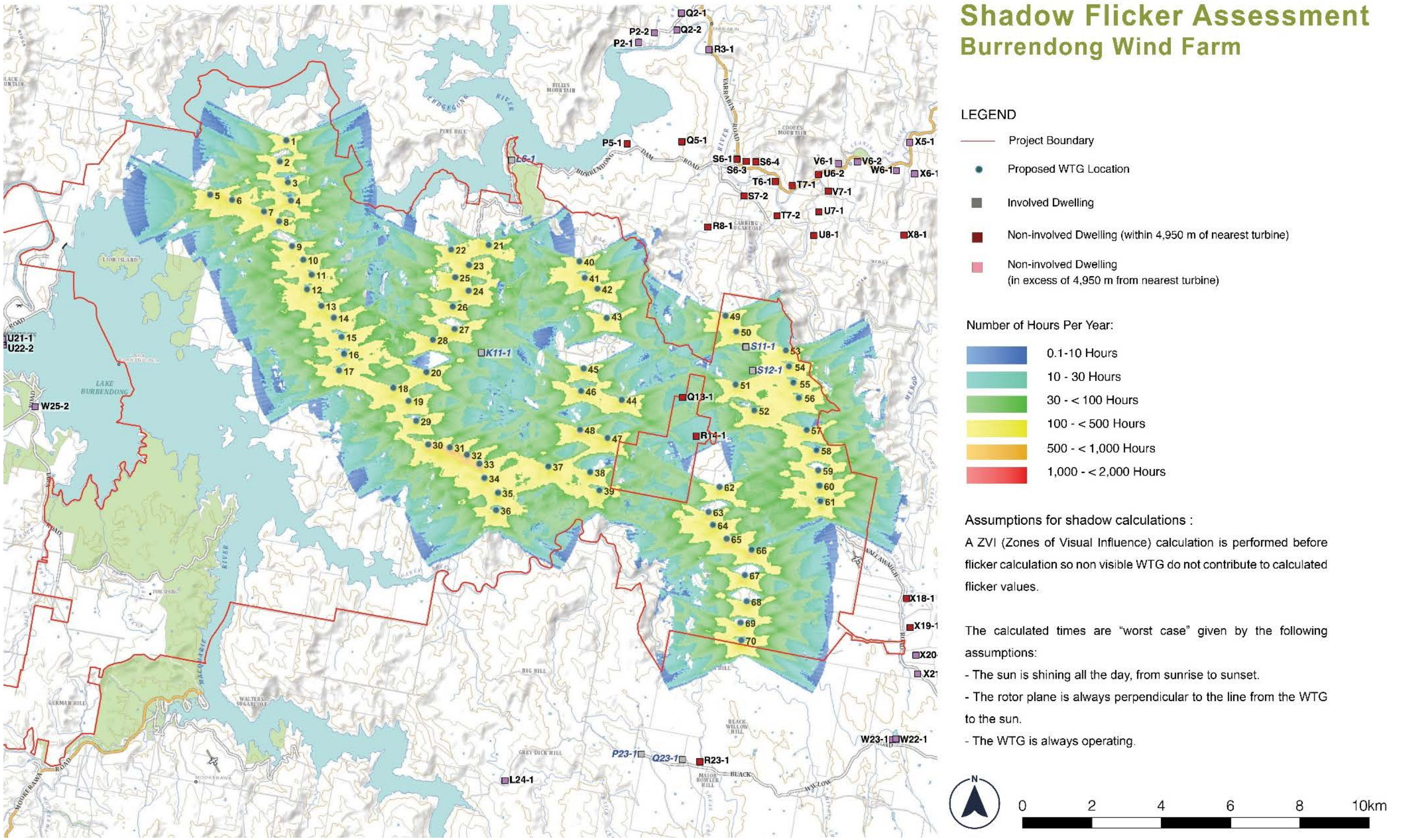


Figure 6-9: Shadow Flicker assessment diagram (MLA, 2023)

6.3.2.6. Ancillary Infrastructure

In addition to the proposed WTGs, ancillary infrastructure associated with the Project is likely to contrast with the existing visual landscape, given its rural nature. An overview of the potential visual impacts resulting from ancillary infrastructure is summarised in Table 6-12.

Table 6-9: Potential visual impacts from proposed ancillary infrastructure (MLA, 2023)

Ancillary Infrastructure	Potential Impact	Reasoning
Internal Roads & Hardstand Areas	Negligible	Due to the existing agricultural land use of the Study Area, farm roads traversing the landscape are a common element in the existing landscape character. The proposed access roads would likely be viewed as part of the existing character of the landscape and therefore visual impacts would be considered negligible in the context of the existing landscape.
Transmission Lines	Negligible	Internal Transmission Lines: Each of the WTGs will be connected to an onsite substation via system of overhead and underground cables. The proposed internal overhead 33 kV transmission lines are in keeping with the scale and appearance of existing power lines which are a common element within the existing rural landscape. External Transmission Lines: A 330 kV single circuit overhead transmission line connection is proposed to connect the onsite substation to the existing overhead 330 kV transmission line network to the western side of Lake Burrendong. Two (2) routes are under consideration. The design of the proposed transmission line will be refined during the detailed design stage, however for the purposes of the LVIA, a worst-case scenario of 50 metres was assumed, a maximum 60 m cleared easement will be required underneath the transmission line. Generally, the above ground transmission lines transverse a large area of uninhabited land surrounded by undulating topography. Opportunities to view the transmission lines are limited due to distance, topography, and vegetation. Additionally, there are no non-involved dwellings within 2,000 m of the preferred transmission line route. Several design principles have been considered to reduce the visual impacts and with the principles employed, the potential visibility of the transmission line is anticipated to be negligible.
Switchyard Preferred Location	Negligible	The switching station is proposed in the southwestern corner of the Project Site on low lying topography and surrounded by rises in topography which will act as a screen for a small pocket of non-involved dwellings associated with Spring Creek Road, Mookerawa. Opportunities to view the switching station are limited to receptors travelling within the Project Site and therefore the potential visual impact has been rated as negligible.
Switchyard Alternate Location	Negligible	The alternate switching station is proposed in the north-western corner of the Project Site between Spring Creek and Carols Rocks Gully on low lying topography and surrounded by rises in the topography. Opportunities to view the alternate switching station are limited to receptors travelling within the Project Site and therefore the potential visual impact has been rated as negligible.
Substation	Negligible	The substation is likely to take up an area of up to 100 m x 200 m. Existing vegetation and topography will screen views to the substation from the surrounding areas of publicly accessible land. Due to its isolated location within the Project Site, the potential visibility has been rated as negligible. If deemed necessary during the detailed design phase, mitigation measures such as screen planting could be employed to reduce any potential visual impacts.

Ancillary Infrastructure	Potential Impact	Reasoning
		It noted that an alternative substation location has been proposed adjacent to the O&M compound location within the centre of the Project Site and has been rated as negligible visual impact.
O&M Compound	Negligible	A permanent O&M compound will be established for day-to-day operations and would take up an area of approximately 150 m x 70 m. A permanent Operations and Maintenance (O&M) facility will be constructed to provide for all operations and maintenance activities associated with the Project. The O&M facility is unlikely to be visible from any nearby dwellings and therefore has a visual impact rating of negligible.
Meteorological Masts	Negligible	Three (3) permanent wind monitoring masts would be required to assist with the control and operation of the Project. These would be static guyed masts with remotely operated wind monitoring equipment installed at multiple heights on each mast and are expected to be around 150 m tall. The temporary and permanent masts would be located within the Project Site boundary and may be visible from some public locations. However, due to the narrow scale, they are generally indiscernible to viewers and have been given a visual impact rating of negligible.

6.3.2.7. Night Lighting

Night lighting has the potential to alter the night-time landscape character of the area. Potential light sources include aviation hazard lighting (AHL) and night lighting for safety and security on ancillary infrastructure.

AVIATION HAZARD LIGHTING

Aviation Hazard Lighting of the Project has the potential to extent the visual effect into the night. AHL has the potential to be visible from distances more than 20 km. However, the distance depends on several variables, including light intensity and topography. Due to the relatively isolated location of the Project, very little existing sources of lighting are present in the night-time landscape.

Considering the high elevation of the WTGs and the implementation of shields, the source of visible light is likely to be reduced to ambient lighting as opposed to direct visibility of the light itself. The greatest impact will likely be felt by those who use the outdoors at night. Dark sky is valued in a rural landscape due to limited light pollution. To assist in the amelioration of the effect of AHL on WTGs, the following measures can be applied:

- If used, aviation lights are generally required to be spaced over the array, particularly at the extremities. They are not required on every tower. Careful consideration of WTGs with which AHL is installed will be taken.
- Treatment of the rear of blades with a non-reflective coating to reduce reflection off the rotating blade at night.
- Use of the lowest candela intensity allowed by CASA.
- Permanent light shielding to reduce the impact on residences within 6 km of the installation.

LIGHT ASSOCIATED WITH ANCILLARY INFRASTRUCTURE

Night lighting is likely to be required on ancillary infrastructure including switching stations, collector substations and facilities buildings. At this stage of the Project, the location and type of lighting required on the proposed substations and facilities buildings is still to be confirmed.

The proposed ancillary infrastructure has been carefully sited to minimise visibility from existing residences and public viewpoints. It is unlikely the proposed night lighting associated with the ancillary infrastructure would create a noticeable impact on the existing night-time landscape. If appropriate design principles are incorporated into the night lighting for ancillary infrastructure. It is likely there will be no visual impacts resulting from night lighting given the ancillary infrastructure is in areas screened by the topography of the landscape. Furthermore, there are no non-associated dwellings within 2,000 m of any ancillary infrastructure, significantly reducing the effect of night lighting in the environment.

6.3.3. Mitigation Measures

Table 6-10 summarises the proposed measures to mitigate landscape and visual impacts of the Project.

Table 6-10: Mitigation measures for potential landscape and visual impacts

Environmental Impact	Mitigation Measure	Reference Code
Visual Amenity	The following principles should continue to guide the design process of the Project during the detailed design phase and micro-siting process: • Controlling the location of different WTG types, densities, and layout geometry to minimise the visual impacts. • The lines of WTGs should reflect the contours of the natural landscape as best as possible. • Ensure the WTGs are evenly spaced to give a regular pattern creating a better balance within the landscape.	**LV001**
	To achieve a visual consistency through the landscape, the following must be considered for WTG design: • Uniformity in the colour, design, rotational speed, height, and rotor diameter. • The use of simple muted colours and non-reflective materials to reduce distant visibility and avoid drawing the eye. • Blades, nacelle, and tower to appear as the same colour. • Avoidance of unnecessary lighting, signage, logos etc.	**LV002**
Blade Glint	To minimise potential visual impacts because of the WTG throughout the landscape, all WTG blades used in the Project should be finished with a low reflectivity surface treatment to reduce the effect of blade glint, as required by the Visual Bulletin (DPE, 2016b)	**LV003**
Non-Involved Dwellings	The existing character of the landscape allows for a variety of methods of landscaping and visual screening in keeping with the landscape character. General guidelines to adhere to when planning for landscape and visual screening include: • Planting post construction in consultation with the landowner. • Keeping with existing landscape character. • Species selection is to be typical of the area. • Avoid screening views of the broader landscape. • Avoid the clearing of existing vegetation. Where appropriate reinstate any lost vegetation. • Allow natural vegetation to regrow over any areas of disturbance.	**LV004**

Environmental Impact	Mitigation Measure	Reference Code
	• Locally native plant species are preferred, as they will help assist and maintain the connectivity of the area, help preserve the landscape character and scenic quality of the area as well as building habitat for local fauna. Native species are also well-suited to local conditions (i.e., soil, climate, etc.) and will build on the existing vegetation in the area.	
Visual Impacts from Ancillary Infrastructure	To reduce the residual impacts resulting from the construction of access roads and hard stands, the following are to be considered: • Where possible utilise or upgrade existing roads, trails or tracks to provide access to the proposed WTGs to reduce the need for new roads. • Allow for the provision for downsizing roads or restoring roads to existing condition following construction where possible. • Any new roads must minimise cut and fill and avoid the loss of vegetation. • Utilise local materials where possible and practical.	**LV005**
	To reduce potential visual impacts resulting from the construction of transmission lines, the following are to be considered at the detailed design phase: • Where possible underground cabling is to be used to connect wind WTGs to the electricity grid. • Utilise existing transmission lines where possible. • The route for any proposed overhead transmission lines should be chosen to reduce visibility from surrounding areas. • Plan route to minimise vegetation loss. • Use of subtle colours and a low reflectivity surface treatment on power poles to ensure that glint is minimised.	**LV006**
	To reduce potential visual impacts resulting from the construction of the O&M compound, the following must be considered: • Siting to ensure minimal vegetation loss. • The type and colour of building materials used. Where possible a recessive colour palette is to be used which blends into the existing landscape. • Avoidance of unnecessary lighting, signage on fences, logos etc. • Any proposed buildings to be sympathetic to existing architectural elements in the landscape. • Minimise cut and fill and loss of existing vegetation throughout the construction process. • Boundary screen planting	**LV007**
Night Lighting	To reduce the potential visual impacts of AHL, the following must be considered: • Although not recommended within the Aeronautical Impact Assessment (Aviation Projects, 2023; Appendix K), if used, space aviation lights over the array, particularly at the extremities. They are not required on every WTG. Where possible, careful consideration of WTGs upon which aviation lighting is installed to avoid unnecessary impact upon residences. • Treatment of the rear of blades with a non-reflective coating to reduce reflection off the rotating blade at night.	**LV008**

Environmental Impact	Mitigation Measure	Reference Code
	• Use of the lowest candela intensity allowed by CASA. • Permanent light shielding is also an option to reduce impact on residences within six (6) km of the installation	
	The following principles should be incorporated into lighting design during the detailed design phase of the switching station, substation, O&M compound, and any other structures requiring lighting: • Only use lighting for areas that require lighting i.e., paths, building entry points. • Switch off lighting when not required. • Consider the use of sensors to activate lighting and timers to switch off lighting. • Use the lowest intensity required for the job. • Use energy efficient bulbs and warm colours. • Direct light downwards. • Ensure lights are not directed at reflective surfaces. • Use non-reflective dark coloured surfaces to reduce reflection of lighting. • Keep lights close to the ground and / or directed downwards. • Use light shield fittings to avoid light spill.	**LV009**

6.4

Noise and Vibration

A Noise and Vibration Impact Assessment (NVIA) has been undertaken by MDA (2023; Appendix G) in accordance with the requirements of the SEARs, which include:

- *Assessment of the wind turbine noise in accordance with the NSW Wind Energy: Noise Assessment Bulletin (EPA/DPE, 2016);*
- *Assessment of the noise generated by ancillary infrastructure in accordance with the NSW Noise Policy for Industry (EPA, 2017);*
- *Assessment of the construction noise under the Interim Construction Noise Guideline (DECC, 2009) and a draft noise management plan if the assessment shows construction noise is likely to exceed applicable criteria);*
- *Assessment of the traffic noise under the NSW Road Noise Policy (DECCW, 2011);*
- *Assessment of vibration under the Assessing Vibration: A Technical Guideline (DECC, 2006); and*
- *Assessment of the cumulative noise impacts (considering other developments in the area).*

Assessment Overview

The NVIA was undertaken in accordance with the Noise Bulletin (DPE, 2016c) to assess the potential impacts of the Project on noise receivers during both the construction and operation phases, as well as the decommissioning phase.

The predicted WTG operational noise levels from the Project were below the Noise Bulletin (DPE, 2016c) base (minimum) criterion of 35 dB LAeq at all non-associated receivers, except for 1 (R14-1). It was concluded that the Project would comply with the operational noise requirements of the Noise Bulletin (DPE, 2016c) at this receiver with a curtailment strategy in place.

The predicted operational WTG noise levels from the Project are all below Noise Bulletin (DPE, 2016c) base (minimum) criterion of 45 dB LAeq for all associated dwellings. Therefore, the Project can be designed and operated to comply with the operational noise requirements of the Noise Bulletin (DPE, 2016c).

The construction activity that would typically occur nearest to receivers is the construction of access roads and cable trenching. During these works, construction noise levels of up to 60 – 65 dB LAeq could be expected for brief periods when road and access work is carried out at distances less than 200 m from a receiver. It is expected that during site access works, only one (1) associated receiver and no non-associated receivers would be located less than 200 m from these types of construction activities. For context, the predicted noise levels are comparable to, and typical of, noise levels produced by general road maintenance works and activity.

Regarding operational infrastructure noise, noise levels from the collector substation are predicted to be below the 35 dB L_{Aeq} night-time project noise trigger level applicable at the nearest receivers.

Mitigation measures have been proposed to mitigate potential impacts of the Project in Section 6.4.3.

6.4.1. Existing Environment

The Project Site is in the Central-West and Orana regions of NSW and is characterised by low background noise consistent with rural areas. The Project will be comprised of wind farm components and associated infrastructure including WTGs, substations, overhead and underground electrical cable routes, and access tracks. A total of seven (7) noise sensitive locations (referred to as receivers) are located within 3 km from the proposed WTG locations. This includes four (4) receivers where a noise agreement is proposed between the landowners and the Proponent, referred to as associated receivers hereafter. The remaining receivers without an agreement with the Proponent are referred to as non-associated receivers. The construction of the Project will generate noise and vibration impacts because of activities occurring both on and off the Project Site of the proposed development.

Consideration of the potential impacts of the Project to members of the broader community have been an important factor in its development and evolution (Figure 2-15). The NVIA (MDA, 2023; Appendix G) was undertaken to assess the impacts of the Project on the existing environment and provide mitigation and management measures that seek to minimise the potential impacts. The minimisation of these noise impacts is a result of the iterative design process of the Project, with the objective to minimise impacts to nearby residences.

6.4.1.1. Background Noise

Under the Noise Bulletin (DPE, 2016c), background noise levels are used to provide the setting of noise limits against which the WTG noise will be assessed. This is due to the need to consider changes in background noise levels and variations to WTG noise levels under various wind conditions.

Background noise monitoring was conducted between December 2020 and March 2022 during 4 separate monitoring periods in accordance with the Noise Bulletin (DPE, 2016c), which adopts the methodology of the South Australian Environment Protection Authority's *Wind Farms – Environmental Noise Guidelines 2009* (South Australia (SA), 2009). Seven (7) background noise monitoring receivers were used, with their locations based on proximity to WTGs as well as the predicted noise contours detailed in the Preliminary Noise and Vibration Impact Assessment (MDA, 2020) undertaken to accompany the Scoping Report (Table 6-11).

Table 6-11: Background noise monitoring locations (MDA, 2023)

Residence ID	Nearest WTG	Distance from Nearest WTG (m)	Direction to Nearest WTG (°)
Q13-1	51	1,581	76°
Q23-1*	70	3,848	26°
R8-1	49	2,613	169°
R14-1	62	1,609	155°
S12-1*	51	633	231°

*INDICATES AN ASSOCIATED RECEIVER. BACKGROUND NOISE LEVELS MEASURED AT THIS RECEIVER ARE PROVIDED FOR INFORMATION ONLY

Following the completion of background monitoring, the Proponent provided further updates to the WTG layout as well as the list of associated and non-associated receivers related to the Project. Changes to the WTG layout (primarily the removal of a cluster of 35 WTGs to the south of the Project) resulted in receiver Q23-1, identified as an associated receiver, being located more than 3.8 km from a WTG. At this distance, Q23-1 would not ordinarily be considered pertinent for inclusion in a background noise survey. However, for the purpose of consistency, Q23-1 has been retained in the assessment with associated noise limits derived in full. Furthermore, as part of the updates to receiver identification provided by the Proponent, two (2) locations (O17-1 and U10-1) were identified as not being dwellings and thus not classed as receivers.

The background noise levels exhibited variations which are consistent with rural areas and are characterised by lower background noise levels during the night period. Under South Australian Environment Protection Authority's *Wind Farms – Environmental Noise Guidelines 2009* (SA, 2009), noise levels are measured using LA_{90}, which is a measure of the decibel (dB) level exceeded for 90% of each sample period. A review of measured background noise levels for the Project shows that LA_{90} noise levels during the day (7 am – 10 pm) and night (10 pm – 7 am) periods are typically below 30 dB LA_{90} for extended periods at low winds. The background noise level (LA_{90}) at a range of wind speeds within the operating range of the proposed WTGs for both day and night periods are outlined in Table 6-12 and Table 6-13, respectively.

Table 6-12: Background noise levels, dB L_{90} - day (7 am - 10 pm) period (MDA, 2023)

Receiver	Hub-Height Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
O17-1**	-	-	-	-	39.0	39.1	39.4	40.1	41.0	42.2
Q13-1	-	-	32.4	32.8	33.3	34.2	35.2	36.4	37.7	39.1
Q23-1*	31.4	32.2	33.2	34.3	35.4	36.6	37.9	39.2	40.7	42.2
R8-1	31.9	32.3	32.6	32.8	33.1	33.5	33.9	34.6	35.5	36.7
R14-1	36.7	36.8	37.0	37.4	38.0	38.6	39.3	40.1	40.9	41.7
S12-1*	-	31.5	31.6	31.8	32.4	33.1	34.1	35.3	36.6	38.1
U10-1**	33.1	33.0	33.3	34.0	34.9	36.0	37.1	38.2	39.0	39.6

NOTE:

*INDICATES AN ASSOCIATED RECEIVER AND IS LOCATED MORE THAN 3.8 KM AWAY FROM A WTG. BACKGROUND NOISE LEVELS MEASURED AT THIS RECEIVER ARE PROVIDED FOR INFORMATION ONLY.

**BACKGROUND NOISE LEVELS ARE PROVIDED FOR INFORMATION ONLY. NOISE LIMITS HAVE NOT BEEN DERIVED FOR THESE LOCATIONS AS THEY ARE NOT CLASSED AS RECEIVERS PER SECTION 6.4.1.1.

Table 6-13: Background noise levels, dB L_{90} - night (10 pm - 7 am) period (MDA, 2023)

Receiver	Hub-Height Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
O17-1**	-	-	-	-	-	31.0	31.6	33.1	35.8	40.1
Q13-1	30.8	30.8	30.9	31.1	31.4	31.8	32.3	32.9	33.6	34.4
Q23-1*	-	-	-	27.2	27.8	29.2	31.1	33.5	36.1	38.9
R8-1	-	-	25.4	25.6	26.3	27.4	28.8	30.4	32.2	34.1
R14-1	-	-	-	22.8	23.3	24.4	26.1	28.4	31.2	34.5
S12-1*	-	-	*26.3*	*26.6*	*27.5*	*28.9*	*30.4*	*31.9*	*33.3*	*34.2*
U10-1**	29.8	30.2	30.6	31.1	31.7	32.4	33.2	34.0	34.9	35.9

NOTE:

Receiver	Hub-Height Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12

*INDICATES AN ASSOCIATED RECEIVER. BACKGROUND NOISE LEVELS MEASURED AT THIS RECEIVER ARE PROVIDED FOR INFORMATION ONLY.

**BACKGROUND NOISE LEVELS ARE PROVIDED FOR INFORMATION ONLY. NOISE LIMITS HAVE NOT BEEN DERIVED FOR THESE LOCATIONS AS THEY ARE NOT CLASSED AS RECEIVERS PER SECTION 6.4.1.1.

6.4.2. Potential Impacts

Given the rural settings in which wind farms are typically built, wind farms are required to adhere to strict noise controls to assess their impacts on potential receivers surrounding the Project Site. Wind farm policies in Australia are among the most stringent international standards and set limits using a combination of a base (or fixed value) limit and an allowable margin above the background. The Noise Bulletin (DPE, 2016c) defines noise limits at relevant receiver locations (residences) as follows:

> *The predicted equivalent noise level (L_{Aeq}, 10 minute), adjusted for tonality and low frequency noise in accordance with these guidelines, should not exceed 35 dB(A) or the background noise (L_{A90}(10 minute)) by more than 5 dB(A), whichever is greater, at all relevant receivers for wind speed from cut-in to rated power of the wind turbine generator and each integer wind speed in between.*

6.4.2.1. Construction Noise

The construction of the Project will generate noise and vibration because of construction activities occurring both within and surrounding the Project Site. In accordance with the issued SEARs, construction noise was assessed in accordance with the *Interim Construction Noise Guideline (ICNG)* (DECC 2009) and construction vibration to be assessed in accordance with the *Assessing Vibration: A Technical Guideline 2006* (AVTG). Typical plant sound power levels range from approximately 100-120 dB L_{WA} per equipment item. The works to be completed at the Project Site will comprise a range of activities including construction of:

- Access road
- WTG foundations
- WTG assembly
- Hardstands
- Substation
- Site compounds
- Overhead transmission lines
- Underground transmission lines (cable trench digging)

Off-site noise generating works includes activities such as OSOM vehicle movements to and from the Project Site. Noise levels associated with each of the main construction tasks have been predicted at the nearest receivers to provide an indication of the upper range of noise levels. Given that the precise equipment selection and methods of working would be determined during the future development of a Construction Noise and Vibration Management Plan (CNVMP), and that the noise associated with construction plant and activity varies significantly, the predicted noise levels are provided in Table 6-14 as an indicative range of levels which may occur in practice.

Construction noise levels are predicted to be above the noise affected management levels at some of the nearest non-associated receivers, during the construction of access roads and site compounds. Construction noise is also predicted to be above the noise affected management levels at some of the nearest associated receivers, during the construction of turbine foundations, hardstands and access roads, site compounds, overhead transmission lines and during cable trench digging. Construction noise is however, predicted to be below the highly noise affected management levels at all non-associated receivers for all assessed construction activities.

Exceedance above the noise affected management levels are not unique to this Project and are characteristic of most construction assessments due to the typically high source noise levels of construction equipment. Based on previous project experience the predicted noise levels are typical of the range expected for the construction of a wind farm.

Due to the proximity of both involved and non-involved receivers to the proposed construction activities, the highest predicted noise levels are noted to occur during the construction of access roads and site compounds. The ICNG provides additional comments with respect to highly noise affected management levels, recommending respite periods and implementation of all *"feasible and reasonable work practices to meet the noise affected level"*. Consultation with involved receivers and negotiation of respite periods will be considered during the preparation of the CNVMP.

Table 6-14: Indicative range of construction noise predictions, dB LAeq (MDA, 2023)

Construction Task	Nearest Receiver	Predicted Level Range	Noise Affected Management Level	Exceedance	Highly Noise Affected Management Level	Exceedance
			Non-Associated Receivers			
WTG foundations	Q13-1	40 – 45	45	-	75	-
WTG assembly	Q13-1	35 – 40	45	-	75	-
Construction of hardstands	Q13-1	40 – 45	45	-	75	-
Access road construction	Q13-1	50 – 55	45	5 – 10	75	-
Substation construction	Q13-1	25 – 30	45	-	75	-
Connection switchyard construction	R14-1	10 – 15	45	-	75	-
O&M site compound	Q13-1	40 – 45	45	-	75	-
Construction of Overhead transmission lines	R14-1	30 – 35	45	-	75	-
Underground transmission lines (Cable trench diffing)	Q13-1	50 – 55	45	5 – 10	75	-
Permanent meteorological masts and footings	Q13-1	30 – 35	45	-	75	-
Concrete batching plant	Q13-1	35 – 40	45	-	75	-
Temporary laydown areas and compounds	Q13-1	40 – 45	45	-	75	-
Temporary and permanent meteorological masts footings	R14-1	25 – 30	45	-	75	-
			Associated Receivers			
WTG foundations	S11-1	50 – 55	45	5 – 10	75	-
WTG assembly	S11-1	45 – 50	45	0 – 5	75	-
Construction of Hardstands	S11-1	50 – 55	45	5 – 10	75	-
Access road construction	S11-1	60 – 65	45	15 – 20	75	-
Substation construction	K11-1	30 – 35	45	-	75	-
Connection switchyard construction	K11-1	10 – 15	45	-	75	-
O&M Site compounds	S12-1	60 – 65	45	15 – 20	75	-

Construction Task	Nearest Receiver	Predicted Level Range	Noise Affected Management Level	Exceedance	Highly Noise Affected Management Level	Exceedance
Construction of Overhead transmission lines	K11-1	30 – 35	45	-	75	-
Underground transmission lines (Cable trench diffing)	S11-1	60 – 65	45	15 – 20	75	-
Permanent meteorological masts and footings	S11-1	45 – 50	45	0 – 5	75	-
Concrete batching plant	S12-1	50 – 55	45	5 – 10	75	-
Temporary laydown areas and compounds	S11-1	55 – 60	45	10 – 15	75	-
Temporary and permanent meteorological masts footings	K11-1	30 – 35	45	-	75	-

Construction noise levels are predicted to be above the noise affected management levels for some receivers, both associated and non-associated, during the construction of access roads and laydown areas and during cable trench digging. Construction noise levels are predicted to be below the highly noise affected management levels at all associated and non-associated receivers for all assessed construction activities, limiting noise impacts to all identified receivers to below that threshold at a minimum.

The construction activity that would typically occur nearest to both involved and non-involved receivers is the construction of access roads. This activity involves a brief period of elevated noise while work is carried out to improve existing roads (where required), create new intersections at site access points, and initiate site access tracks. During these initial works, construction noise levels of up to 60-65 dB L_{Aeq} could be expected for brief periods when road and access work is carried out at distances less than 200 m from a receiver. It is expected that during site access works, only one (1) (S11-1) associated receiver and no non-associated receivers would be located less than 200 m from these types of construction activities. For context, the predicted noise levels are comparable to, and typical of, noise levels produced by general road maintenance works and activity.

Like the construction of access roads, cable trench digging activities will generally move along the intended routes reasonably quickly, as construction progresses throughout the Project Site. On this basis trench digging activities generally alongside access road construction are unlikely to be a feature of any one receiver for an extended period. This is due to the frequently changing location of the works at a given time as it is unlikely for road and cabling works to continue at a single site for a long period of time. During these initial works, construction noise levels of the order of 65-70 dB L_{Aeq} could be expected for brief periods when cable trench digging activities are carried out at distances less than 250 m from a receiver. It is expected that during this stage of works, 2 associated receivers and no non-associated receivers would be located less than 250 m from this construction activity.

Most of the remainder of construction activities occur in proximity to the WTG and related infrastructure locations. These works typically occur at larger distances from receivers. As a result, construction noise levels are lower. However, depending on background noise levels and wind directions, construction noise associated with more distant works would still be audible at surrounding receivers at times. Given the low background noise levels that occur in rural environments at low wind speeds, construction noise could be higher than background noise levels on some occasions.

6.4.2.2. Construction Vibration

MDA (2023; Appendix G) undertook a vibration assessment in accordance with the *Assessing Vibration: A Technical Guideline 2006* (AVTG). The ATVG does not have mandatory standards or set objective criteria and is instead focused on setting feasible and practicable vibration reduction measures. The prediction of vibration propagation through the ground is complex and subject to considerable uncertainty. The AVTG provides goal vibration levels based on the following definitions:

- Continuous Vibration: Uninterrupted for an extended period
- Intermittent Vibration: An interrupted form of continuous vibration
- Impulsive: A sudden event or events resulting in vibration

For this assessment, only residential receivers were considered, both associated and non-associated. The AVTG indicates that intermittent vibration should be assessed in terms of the Vibration Dose Value

(VDV). These values for intermittent construction activities are highly specific to site conditions, equipment selections and operational durations. As such, calculation of VDV levels is not typical or practical at the planning stage. Due to the complexity of the calculations required as well as the general lack of information, calculations of VDV would only be considered for activities being undertaken near to receiver locations.

Vibration due to some construction operations can be considered continuous depending on the duration and nature of the works. Since the guide values for continuous vibration are independent of exposure duration, indicative safe working distances can be developed. Section 7.1 of the NSW RMS *Construction Noise & Vibration Guideline* (CNVG, 2016) sets out minimum working distances from sensitive receivers (such as residential receivers) for typical items of vibration intensive plant. The CNVG notes that the minimum working distances for human comfort relate to continuous vibration and are indicative. In practice, appropriate minimum working distances will vary depending on the item of plant and local geotechnical conditions. The CNVG further notes that for most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods are allowed, likely equating to greater minimum working distances.

BLASTING

The excavation methods that will be needed to prepare the foundations of the WTGs and other on-site infrastructure are yet to be confirmed. However, low level blasting may be required in some instances. The accurate estimation of air blast and ground vibration is complex and subject to considerable uncertainty. The blasting process is highly non-linear, and the variability of ground and rock also contributes to the difficulty in accurate predictions. However, if blasting is ultimately required, the activities would need to be addressed in a blasting plan which sets out the management and monitoring measures to be implemented, including identification of the locations where blasting could be conducted, if required, in accordance with the Australian and New Zealand Environment Council Report *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (ANZEC 1990 Report).

Once further information is known it may be feasible to establish general indications of air blast overpressure and ground vibration levels at the nearest receivers to the proposed blasting areas, by undertaking a high-level assessment in accordance with AS 2187-2:2006 *Explosives – Storage, transport and use, Part 2: Use of explosives* (AS 2187-2).

TRAFFIC NOISE

Traffic generation during operational stages is limited, with construction stage traffic likely to comprise most of the traffic associated with the Project. On this basis, operational traffic on public roads is not considered further in this report as it is likely to be very low and have negligible noise impacts. Most of the traffic noise associated with the Project will likely occur within the standard work hours, however the delivery of oversized WTG components may occur outside of normal hours to minimise traffic disruption.

The estimated construction traffic flows on public roads have been provided by Stantec (2023) and are outlined in Table 6-50.

In considering feasible and reasonable mitigation measures, the *Road Noise Policy* (DECCW, 2011) states that an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person. On this basis, to assess noise impacts from construction traffic, an initial screening test is undertaken in the following section to evaluate whether existing road traffic noise levels would increase beyond this threshold. Where the predicted traffic noise increase is 2 dB or less, no further assessment is conducted, as impacts will be barely perceptible. However, where the road traffic noise levels are predicted to increase by more than 2 dB because of additional traffic, consideration is given to the actual noise levels associated with the construction traffic and whether these levels comply with the *Road Noise Policy*.

For the freeway / arterial / sub-arterial roads listed in Table 6-46, the increase in road traffic is relatively minor compared to the existing traffic flows, less than a 25 % increase in all cases. Based on the estimated construction traffic flows, the relative increase in traffic noise level associated with construction activities is predicted below the 2 dB threshold during the day and night periods. Therefore, further detailed noise level predictions and assessments at receivers along the identified freeways / arterial / sub-arterial roads were not carried out. However, the local roads listed in Table 6-46 all have very low existing traffic flows and, as such, any increase in flow, for example from 2 vehicles to 4 vehicles, may give rise to a large relative increase. The relative traffic noise level increase due to the proposed construction activities is predicted to be above the 2 dB threshold.

Table 6-15 shows a summary of the minimum setback distance from local roads, beyond which compliance with the RNP criteria is predicted to be achieved during the day and night periods. No receivers were identified within the minimum setback distance, where traffic noise is predicted above the RNP criteria. It is noted that although the absolute noise levels are predicted to comply with the RNP criteria at relevant receivers, increased traffic levels may result in noticeable increases in noise during some periods of construction.

Table 6-15: Construction traffic and base traffic flows on local public roads (MDA, 2023)

Road	Minimum Setback for Compliance (m)		Identified Receivers within Minimum Setback Zone
	Day	Night	
Twelve Mile Road	15	10	None
Yarrabin Road	25	10	None
Burrendong Dam Road	30	10	None

SLEEP DISTURBANCE DUE TO CONSTRUCTION TRAFFIC

Most construction traffic movements are expected to occur during the day period only. However, during some construction stages OSOM vehicles will be required for the delivery of larger items. Movements on local roads during the night period are more likely to be associated with OSOM deliveries during months 7 – 9 of the Project. Utilising the traffic sleep disturbance criteria provided in Appendix G, an external noise level screening threshold of 65 dB LAmax has been established to assess the potential for sleep disturbance due to construction traffic during OSOM delivery. A maximum external noise level of 65 dB or higher is predicted at receivers within 40 m of the OSOM vehicle movement. Based on an aerial review of receivers along the subject roads, no receivers within 40 m of Burrendong Dam Road were identified. However, up to two (2) receivers along both Yarrabin Road and Twelve Mile Road were identified within 40 m. Sleep disturbance impacts are not anticipated under the typical working hours during construction. During occasions where OSOM deliveries must be carried out during night periods, reasonable and feasible noise mitigations will assist in reducing potential impacts, including consultation with the four identified residences prior to OSOM deliveries scheduled during the night period.

6.4.2.3. Operational Wind Turbine Generator Noise

Noise levels for WTGs of operational wind farms are predicted using:

- Noise emission data for the WTGs.
- A 3D digital model of the site and the surrounding environment.
- International standards used for the calculation of environmental sound propagation.

The method selected to predict noise levels is the International Standard ISO 9613-2: 1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* (ISO 9613-2). The prediction method is consistent with the guidance provided in the SA, 2009 (accepted by and referenced in the Noise Bulletin (DPE, 2016c)) and has been shown to provide a reliable method of predicting the typical upper levels of the noise expected to occur in practice.

Noise emissions of WTGs are described in terms of the sound power level for different wind speeds. The sound *power* level is a measure of the total sound energy produced by each WTG and is distinct from the sound *pressure* level which depends on a range of factors. Sound power level data for the candidate WTG model has been sourced from the following documents as provided by the Proponent:

- 0105-5200_00 Third octave noise emission EnVentus™ V162-6.2MW dated 21 April 2021 (unconstrained operation); and
- 0079-5298_01 V162-5.6MW Third octave noise emission dated 23 January 2019 (sound optimised modes).

For the purposes of this assessment, the Proponent has considered 1 candidate WTG model detailed in Table 6-16 below. The candidate WTG model is a variable speed WTG, with the speed of rotation and the amount of power generated by the WTG regulated by control systems that vary the pitch of the WTG blades (the angular orientation of the blade relative to its axis).

Table 6-16: Candidate WTG model details (MDA, 2023)

Item	Details
Make and Model	Vestas V162-6.2MW
Rated Power	6.2 MW
Rotor Diameter	162 m
Modelled Hub Height	149 m
Modelled Tip Height	230 m
Operating Mode	PO6200
Serrating Trailing Edge	Yes

Based on the data sourced from the above specification, the noise modelling conducted for this assessment involved conversion of third octave band levels to octave band levels and adjustment by addition of +1.0 dB at each wind speed to provide a margin for typical values of test uncertainty.

The overall A-weighted sound power levels (including the +1 dB addition) as a function of hub height wind speed are presented in Table 6-17. The reference octave band values used as the basis for this assessment are presented in Table 6-18 and were adjusted to the overall A-weighted noise levels detailed in Table 6-17.

Table 6-17: Sound power levels versus hub height wind speed, dB L_{WA} (MDA, 2023)

Operating Mode	Power Output (MW)	Hub Height Wind Speed (m/s)								
		4	5	6	7	8	9	10	11	≥12
PO6200	6.2	95.1	95.3	97.2	100.2	103.0	105.3	105.8	105.8	105.8
Mode 0	5.6	94.7	95.3	98.3	101.2	103.9	105.0	105.0	105.0	105.0
SO2	5.0	94.7	95.3	98.3	101.2	103.0	103.0	103.0	103.0	103.0
SO3	4.8	94.7	95.3	98.3	101.2	102.0	102.0	102.0	102.0	102.0
SO4	4.6	94.7	95.3	98.3	100.7	101.0	101.0	101.0	101.0	101.0

Table 6-18: Octave band sound power levels, dB L_{WA} (MDA, 2023)

Operating Mode	Octave Band Centre Frequency, Hz								
	31.5	63	125	250	500	1000	2000	4000	8000	TOTAL
PO6200*	76.7	87.1	94.6	99.2	100.9	99.8	95.7	88.8	79.0	105.8

**Based on one-third octave band levels at 10 m/s*

The values presented above are considered typical of the range of noise emissions associated with comparable multi-megawatt WTGs. A review of available sound power data for a range of WTG models has shown that there is no clear relationship between WTG size or power output and the noise emission characteristics of a particular WTG model. Rather, the overall noise emissions of a WTG are dependent on a range of factors, including the WTG size and power output, and other factors such as blade design and rotational speed. While WTG sizes and power ratings of contemporary WTGs have increased, the noise emissions of the WTGs are comparable to, or lower than, previous generations of WTGs because of design improvements.

6.4.2.4. Operational Infrastructure Noise

The proposed ancillary infrastructure includes power transmission networks and one (1) collector substation with two (2) location options. Operational noise predictions have been undertaken for both location options, with the approximate coordinates provided in Table 6-19. The predicted noise levels have been assessed in accordance with the NSW EPA *Noise Policy for Industry* and demonstrated that the related infrastructure complied with the most stringent night-time project noise trigger level at all receivers. The approximate coordinates used for the assessment of related operational infrastructure noise are detailed in Table 6-19.

Table 6-19: Approximate related infrastructure coordinates (GDA 2020 Zone 55) (MDA, 2023)

Infrastructure Item	Easting (m)	Northing (m)
Collector substation (east)	712,760	6,379,631
Collector substation (west)	707,625	6,381,342

Specific details of the transformer make, and model are yet to be determined. However, to provide a basis for assessing the feasibility of the proposed terminal station, the Proponent advised that two (2) transformers rated to 350 MVA are proposed to be installed within the collector substation. In lieu of measured sound power level data for a specific transformer selection, reference has been made to *Australian Standard AS 60076-10:2009 Power transformers – Part 10: Determination of sound levels* (AS 60076-10:2009) which provides a method for estimating transformer sound power levels. Specifically, Figure ZA1 from AS 60076-10:2009 has been used to determine an estimated standard maximum sound power level of 102 dB L_{WA} for each transformer.

To assess the potential impacts of operational infrastructure noise, noise levels have been predicted at the nearest non-involved and involved receivers based on the method described above. As equipment selections are not known, the tonality characteristics of the transformers cannot be anticipated. To provide a conservative assessment, an adjustment of +5 dB (as per the *Noise Policy for Industry* (NPfI) (EPA, 2017)) has been applied to the predicted noise levels to account for the potential tonal characteristics of transformer noise.

Predicted noise levels from each equipment location at the nearest non-associated receivers are shown in Table 6-20.

Table 6-20: Predicted noise levels at the nearest non-associated and associated receivers (inc. +5 dB tonality penalty), dB L_{Aeq} (MDA, 2023)

Infrastructure Item	Nearest Receiver	Distance (m)	LAeq
	Non-associated receiver		
Collector substation (east)	Q13-1	4,055	14
Collector substation (west)	Q13-1	8,850	< 10
	Associated receiver		
Collector substation (east)	K11-1	3,604	19
Collector substation (west)	K11-1	3,261	17

While the specific equipment selections would not be finalised until the detailed design phase of the Project, noise levels from the transformers are predicted to be below the 35 dB L_{Aeq} night-time project noise trigger level applicable at the nearest receiver by up to 16 dB. Noise from the ancillary electrical infrastructure is therefore predicted to be below the most stringent applicable noise level criteria, even accounting for any adjustments (if applicable at the receiver) for the potential tonal characteristics associated with transformers.

6.4.2.5. Non-Associated Receivers

A-weighted WTG noise levels were predicted at surrounding non-involved receivers to help assess compliance with noise limits. The predictions were made for conditions when the WTG's noise emissions have reached their highest level (corresponding hub height wind speeds of 10 m/s for the candidate WTG model) and the wind is directed from the Project to each receiver. As shown in Table 6-21, the predicted WTG noise levels from the Project are above the Noise Bulletin (DPE, 2016c) base (minimum) criterion of 35 dB L_{Aeq} at 1 non-associated receiver.

Table 6-21: Highest predicted noise level at non-associated receivers with predicted levels above 30 dB L_{Aeq} (MDA, 2023)

Receiver	Noise Bulletin Minimum Criteria	Predicted Noise Level (Candidate Model)	Distance to Nearest WTG (m)	Minimum Criteria Achieved (Y/N)
		Non-Associated Receivers		
Q13-1	35 dB	35.0	1,587	Yes
R8-1	35 dB	26.8	2,618	Yes
R14-1	35 dB	36.0	1,617	No

At the 1 non-associated receiver where the minimum criteria was not achieved, an assessment of compliance required further consideration of the derived noise limits based on the background noise levels measured. The predicted noise levels, noise limits and precited excess over the applicable noise limits for receiver R14-1 is summarised in Table 6-22. WTG noise levels are predicted to be above the applicable noise limits at receiver R14-1 at hub height wind speeds of 9 m/s and 10 m/s by up to 1.0 dB.

Table 6-22: Predicted noise levels, noise limits and excess at receiver R14-1 (MDA, 2023)

Predicted Noise Levels and Excess for Receiver R-14-1	Hub-Height Wind Speed (m/s)							
	5	6	7	8	9	10	11	>12
Predicted Noise Levels (dB L_{Aeq})	25.5	27.4	30.4	33.2	35.5	36.0	36.0	36.0
Applicable Noise Limits (dB L_{Aeq} – Night Period	35.0	35.0	35.0	35.0	35.0	35.0	36.2	39.5
Predicted excess over the applicable noise limits (dB L_{Aeq})	-9.5	-7.6	-4.6	-1.8	0.5	1.0	-0.2	-3.5

To reduce WTG noise levels within this wind speed range, an example curtailment strategy is proposed to be applied to 3 WTGs, as detailed in Table 6-23. The example curtailment strategy presented is only one of the many configurations possible to achieve the required noise reduction. If required, a detailed curtailment strategy accounting for both wind speeds and wind directions would be specified during detailed design once the Project has been approved, the layout finalised, and the WTG model selected.

Table 6-23: Example curtailment strategy (MDA, 2023)

WTG	Hub Height Wind Speed (m/s)	
	9 m/s	10 m/s
51	Operating Mode SO4	Operating Mode SO4
52	Operating Mode SO2	Operating Mode SO4
62	-	Operating Mode SO2

6.4.2.6. Associated Receivers

A-weighted WTG noise levels were predicted at surrounding associated receivers to help assess compliance with noise limits. As shown in Table 6-24, the predicted WTG noise levels from the Project are all below Noise Bulletin (DPE, 2016c) base (minimum) criterion of 45 dB L_{Aeq}. The below findings support that the Project can be designed and operated to comply with the operational noise requirements of the Noise Bulletin (DPE, 2016c).

Table 6-24: Highest predicted noise level at involved receivers with predicted levels above 30 dB L_{Aeq} (MDA, 2023)

Receiver	Noise Bulletin Minimum Criteria	Predicted Noise Level	Distance to Nearest WTG (m)	Minimum Criteria Achieved (Y/N)
K11-1	45 dB	37.2	1,041	Yes
L6-1	45 dB	34.8	2,534	Yes
S11-1	45 dB	4039	535	Yes
S12-1	45 dB	40.6	651	Yes

It can be seen from Table 6-24 that the predicted noise levels from the Project are below the 45 dB L_{Aeq} reference level for all associated receivers. The above findings support that the Project can be designed and operated to comply with the operational noise requirements of the Noise t Bulletin (DPE, 2016c) at all involved receivers.

The location of the total predicted 30 dB, 53 dB, 40 dB, and 45 dB L_{Aeq} noise contours are illustrated in Figure 6-10.

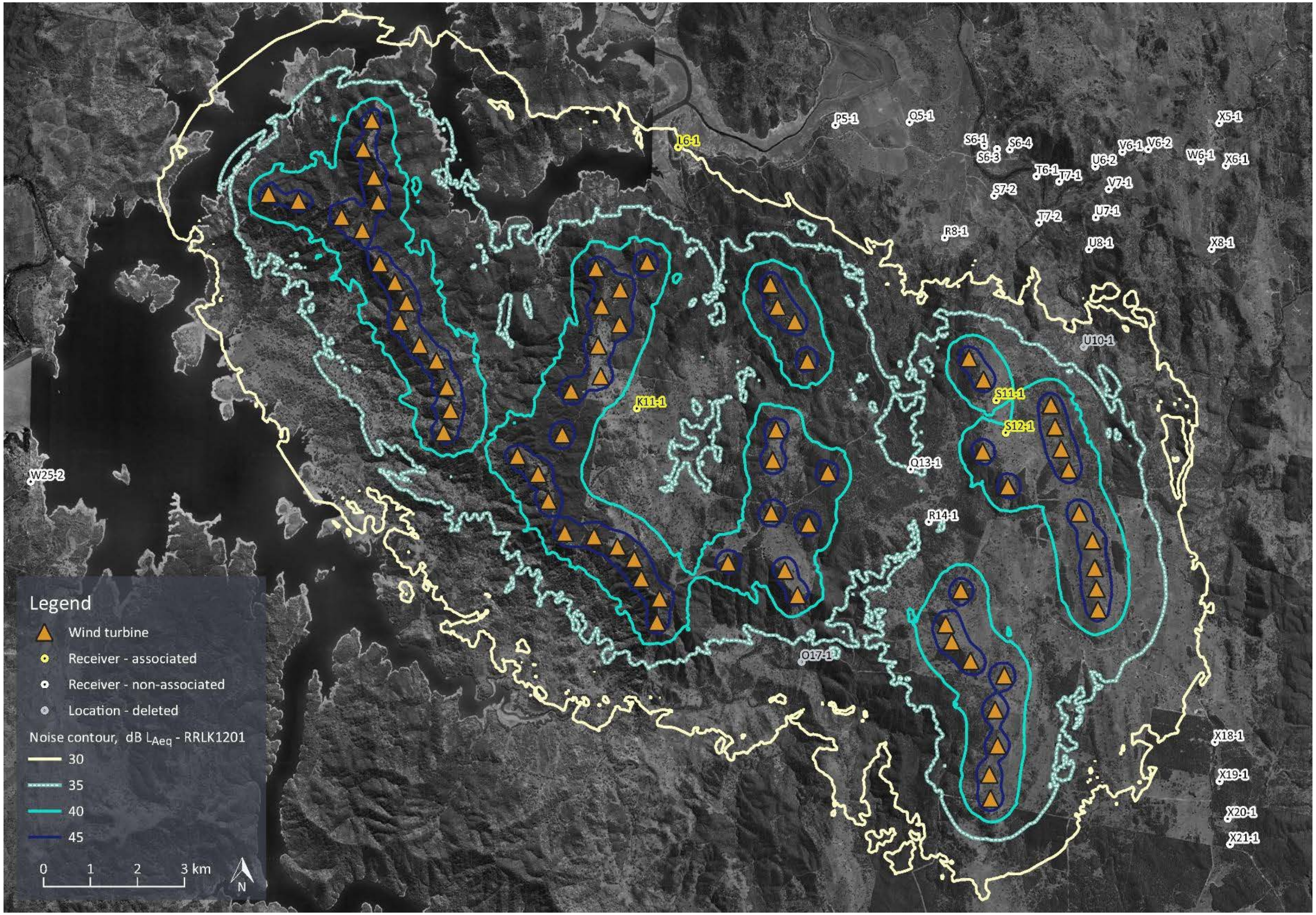


Figure 6-10: Highest predicted noise level contours (MDA, 2023)

6.4.2.7. Tonality

Sounds which have unusually high levels of energy in a relatively narrow band of frequencies may be referred to as being tonal. Audible tonal sounds from WTGs are generally related to rotational equipment in the WTG nacelle and can have a specific pitch dependent on the speed of rotation. This can cause the noise to be more annoying or noticeable. These tonal characteristics typically do not occur in well designed and well-maintained WTGs.

Information concerning potential tonality is often limited at the planning stage of a Project, and narrow band test data for tonality is presently unavailable for the candidate WTG models. The test data for tonality is presented in the form of IEC 61400-11 tonality data as referenced in the SA Wind Farms Environmental Noise Guidelines (SA EPA, 2009). However, the occurrence of tonality in the noise of contemporary multi-megawatt WTG designs is unusual. This is supported by evidence of operational wind farms in Australia which indicates that the occurrence of tonality at receivers is atypical.

MDA (2023; Appendix G) assessed the third octave band data detailed in the manufacturer's specification against the additional tonality test prescribed in Section 3.1.2 of the Noise Bulletin (DPE, 2016c). This test did not indicate the presence of tonality at any of the available hub height wind speeds. On this basis, adjustments for tonality have not been applied to the predicted noise levels presented in this assessment. Notwithstanding this, the potential for tonality would be subject to further review and controls (i.e., contractual performance specifications) during the procurement stage of the Project, following approval of the Project, and again following construction of the Project.

6.4.2.8. Low Frequency Noise

Low frequency noise is present in all types of environmental noise and is particularly difficult to measure in the present of wind due to the increased level of background noise. The Noise Bulletin (DPE, 2016c) indicates that low frequency noise is typically not a significant feature of modern WTG noise when it complied with the A-weighted noise limits. In the unlikely event that excessive low frequency noise is found to be a repeated characteristic of WTG noise, 5 dB should be added to the predicted or measured WTG noise levels.

The Noise Bulletin (DPE, 2016c) prescribes criterion for the application of low frequency noise penalty adjustments, based on C-weighted noise levels. However, there is no established or verified engineering method for the prediction of C-weighted noise levels associated with the operation of WTGs. An assessment of C-weighted WTG noise levels must be undertaken against the 60 dB L_{Ceq} criteria at receivers in the vicinity of the Project.

For this assessment, MDA (2023; Appendix G) adopted a risk assessment approach using a simplified prediction method to estimate C-weighted noise levels (Table 6-25). The risk assessment indicates calculated low frequency noise levels are below the stringent threshold of 60 dB L_{Ceq} (DPE, 2016c) for the application of 5 dB penalties at all non-associated and associated. On this basis, adjustments for low frequency noise have not been applied to the predicted noise levels presented in this assessment. While there are limitations on the accuracy of the prediction method used, the approach is considered sufficiently conservative for the purposes of this assessment.

Table 6-25: Predicted C-weighted noise levels at associated and non-associated receivers (dB L_{Ceq}) (MDA, 2023)

Receiver ID	Noise Bulletin Minimum Criteria	Predicted Noise Level	Minimum Criteria Achieved (Y/N)
	Non-Associated Receivers		
Q13-1	60 dB	56.0 dB	Yes
R8-1	60 dB	50.5 dB	Yes
R14-1	60 dB	56.5 dB	Yes
	Associated Receivers		
K11-1	60 dB	57.7 dB	Yes
L6-1	60 dB	53.2 dB	Yes
S11-1	60 dB	59.5 dB	Yes
S12-1	60 dB	59.5 dB	Yes

6.4.3. Mitigation Measures

Table 6-26 summarises the proposed measures to mitigate Noise and Vibration impacts of the Project.

Table 6-26: Mitigation measures for potential noise and vibration impacts

Environmental Impact	Mitigation Measure	Reference Code
Construction Noise	Develop a detailed CNVMP that includes site and process specific noise management work practices designed to mitigate the impact of construction noise activities, including traffic noise and blasting. Noise mitigation practices can be undertaken by considering the following as part of the CNVMP, including: • Universal work practices • Consultation and notification • Plant and equipment • On-site controls • Work scheduling • Transmission path and at-receiver considerations	NV001

	Conduct the majority of noisy works within normal working hours set out in the 2004 Interim Construction Noise Guidelines. This will assist in limiting noisy activities to times of the day when intrusive impacts or adverse reactions may be less likely. These times include:
	• Normal construction
	  o Monday to Friday (7am – 6pm)
	  o Saturday (8am – 1pm)
	  o No work on Sundays or Public Holidays
	• Blasting
	  o Monday to Friday (9am – 5pm)
	  o Saturday (9am – 1pm)
	  o No blasting on Sundays or Public Holidays
		NV002

	Where out of hours works are proposed the proponent should: • Provide a strong justification as typically required for works outside the recommended standard hours. • Apply all feasible and reasonable work practices to meet the noise affected level.	NV003

Environmental Impact	Mitigation Measure	Reference Code
	Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, negotiate with the community.	
Operational Noise	The predicted operational WTG noise levels should be updated with the final layout and sound power levels of the final WTG selected for the site to verify compliance with the criteria in accordance with the Noise Bulletin (DPE, 2016c).	NV004
	The predicted operational related infrastructure noise levels should be updated with the final design and sound power levels of the final equipment selection to verify compliance with the criteria in accordance with the NPfI.	NV005
	Following construction, compliance monitoring should be conducted to satisfy the Noise Bulletin (DPE, 2016c) including evaluation of special noise characteristics.	NV006
	Prepare an Operational Noise Management Plan, which identifies how compliance with the Project's operational noise limits will be demonstrated, including details of testing procedures and reporting time frames following commencement of operation of the Project	NV007
Noise Reduction Contingency Plans	*Procurement contract*: the procurement contract for the supply of turbines to the site will typically include specifications concerning the allowable total noise emissions from the turbine, and the permissible characteristic of the turbine. If WTG emissions are found to exceed the contracted values, the supplier will be required to implement measures to reduce the noise to a contracted value. This can include measures to rectify manufacturing defects or appropriate control settings.	NV008
	Noise reduction management strategy: modern wind farms include control systems which enable the operation of the turbines to be varied according to environmental constraints. Specifically, variable pitch turbines as proposed for this site include control functions which enable the noise emissions of the turbines to be selectively controlled; by adjusting the pitch of the blade, the noise emissions of the turbine can be reduced. In addition, where required, curtailment can be applied to the turbines under relevant wind speeds and directions. These types of control measures can be used separately, or in combination, to achieve noise reductions for predetermined wind speed ranges and directions.	NV009

6.5 Biodiversity

A Biodiversity Development Assessment Report (BDAR) (ELA, 2023a, Appendix H) has been prepared in accordance with the requirements of the SEARs, which include:

- *An assessment of the biodiversity values and the likely biodiversity impacts of the project, including impacts associated with transport route road upgrades and indirect impacts on Lake Burrendong State Park in accordance with the Biodiversity Conservation Act 2016 (NSW) (BC Act), the Biodiversity Assessment Method (BAM) 2020 and documented in a Biodiversity Development Assessment Report (BDAR), including a detailed description of the proposed regime for avoiding, minimising, managing and reporting on the biodiversity impacts (including on grasslands) of the development over time, and a strategy to offset any residual impacts of the development in accordance with the BC Act;*
- *Assessment of the likely impacts on listed aquatic threatened species, populations, or ecological communities, scheduled under the Fisheries Management Act 1994, and a description of the measures to minimise and rehabilitate impacts, including impacts to Burrendong Dam, Lake*

Burrendong, Macquarie River, Cudgegong River, Meroo River and others;

- *Assess the likely impacts on koalas and their habitat; and*
- *Assess the impact of the project on birds and bats from blade strikes, low air pressure zones at the blade tips (barotrauma), and alteration to movement patterns resulting from the turbines and considering cumulative effects of other wind farms in the vicinity; and*
- *If an offset is required, include details of the measures proposed to address the offset obligation.*

Assessment Overview

The Project Site encompasses two IBRA regions, native vegetation, previously cleared and agricultural land as well as several dams.

Biodiversity impacts have been assessed through survey, mapping and assessment completed in accordance with the BAM. The Project Site includes areas of endangered ecological communities (EECs):

- Grey Box Grassy Woodland
- Box Gum Woodland

Three (3) species of threatened bats, one (1) mammal and four (4) species of birds (one migratory species) were detected during field surveys:

- *Chalinolobus dwyeri* (Large-eared Pied Bat)
- *Haliaeetus leucogaster* (White-bellied Sea Eagle)
- *Hieraaetus morphnoides* (Little Eagle)
- *Hirundapus caudacutus* (White-throated Needletail)
- *Miniopterus orianae oceansis* (Large Bent-winged Bat)
- *Phascolarctos cinereus* (Koala)
- *Polytelis swainsonii* (Superb Parrot)
- *Vespadelus troughtoni* (Eastern Cave bat).

Although detected onsite, it was concluded that after extensive inspection of rocky habitat that no specialized breeding, roosting or refuge habitat were present for threatened bats within the Project Site, and as such, no species credits for threatened bats would be generated.

An assessment of the impacts of the project on matters of national environmental significance (MNES) within the Project Site was undertaken. All assessments concluded that no significant impacts to MNES are predicted, however the Project was referred to the Department of Agriculture, Water and Environment (DAWE) and was considered a Controlled Action on 2 June 2021.

While the Project has aimed to avoid biodiversity values through an iterative design process, a suite of mitigation measures, including the preparation of a Biodiversity Offset Strategy and Bird & Bat Adaptive Management Plan (BBAMP) have been proposed to manage residual impacts as described in Section 6.5.3.

6.5.1. Existing Environment

6.5.1.1. Bioregional context

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies land surfaces based on major environmental factors, which influence the occurrence of flora and fauna in each region. IBRA bioregions are a large-scale classification while subregions are more localised. The Project Site is located across two IBRA regions and subregions:

- South Western Slopes bioregion and Inland Slopes subregion (428.8 ha), consisting of primarily road access and transmission corridors
- The majority of the windfarm itself is located in the South Eastern Highlands (SEH) bioregion and Hill End subregion (426.2 ha).

This has relevance to the assessment of the Project within the BDAR as two Biodiversity Assessment Method (BAM) calculators (BAMC) were required to separate the impact areas within each IBRA region. The current percentage of native vegetation cover within the 500 m buffer area surrounding the Project Site was calculated to be 91% within the South Western Slopes Bioregion and 99 % for the SEH Bioregion.

6.5.1.2. Landscape features

The vegetation within the Project Site is modified by both historical and ongoing farming practices consisting of a mix of remnant woodlands and forests. Native vegetation particularly on the undulating lower hillslopes and on the low-lying flats around Lake Burrendong has been cleared. Vegetated areas are limited to steeper slopes or other areas not suitable for grazing purposes. Many of the WTG locations are located on cleared ridgelines that have been long-term grazed by sheep and these current farming practices will continue next to the WTGs.

6.5.1.3. Plant Community Types

Twelve (12) PCTs were identified within the Development Footprint, plus non-PCT areas of cleared land, roads, and existing dams (Table 6-27, Figure 6-11). Of these, seven (7) are associated with TECs under the BC Act and/or EPBC Act. The majority of the Development Footprint is located on non-TEC PCTs. PCTs are described in further detail in Table 6-28.

Table 6-27: PCTs within Project Site

PCT ID	PCT Name	Total area across both IBRAs (ha)	Percentage Cleared
PCT 76	Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	3.37	92%
PCT 84	River Oak – Rough-barked Apple – red gum -box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion	6.65	40%
PCT 266	White Box grassy Woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion	88.4	94%
PCT 270	White Box – Tumbledown Reg Gum – Long-leaved Box shrub/grass woodland in fine-grained sediments of the upper Macquarie River Gorge, NSW central western slopes.	0.13	40%
PCT 272	White Box – Black Cypress Pine – red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes	404.4	65%

PCT ID	PCT Name	Total area across both IBRAs (ha)	Percentage Cleared
PCT 274	White Box – Rough-barked Apple alluvial woodland of the NSW central western slopes including in the Mudgee Region	1.15	88%
PCT 277	Blakely's Red Gum – Yellow Box grassy tall woodland on the NSW South Western Slopes Bioregion	17.5	94%
PCT 281	Rough-barked Apple – red gum – Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	3.4	67%
PCT 287	Long-leaved Box – red box – Red Stringybark mixed open forest on hills and hillslopes in the NSW South Western Slopes Bioregion	222.6	67%
PCT 312	Yellow Box grassy tall woodland on valley flats in the upper slopes of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	0.5	93%
PCT 331	Red Stringybark woodland on hillslopes, northern NSW South Western Slopes Bioregion	52.3	20%
PCT 461	Tumbledown Gum woodland on hills in the northern NSW South Western Slopes Bioregion and southern Brigalow Belt South Bioregion	2.08	50%
0	Cleared, Roads, Dams	52.5	-
TOTAL		**855**	-

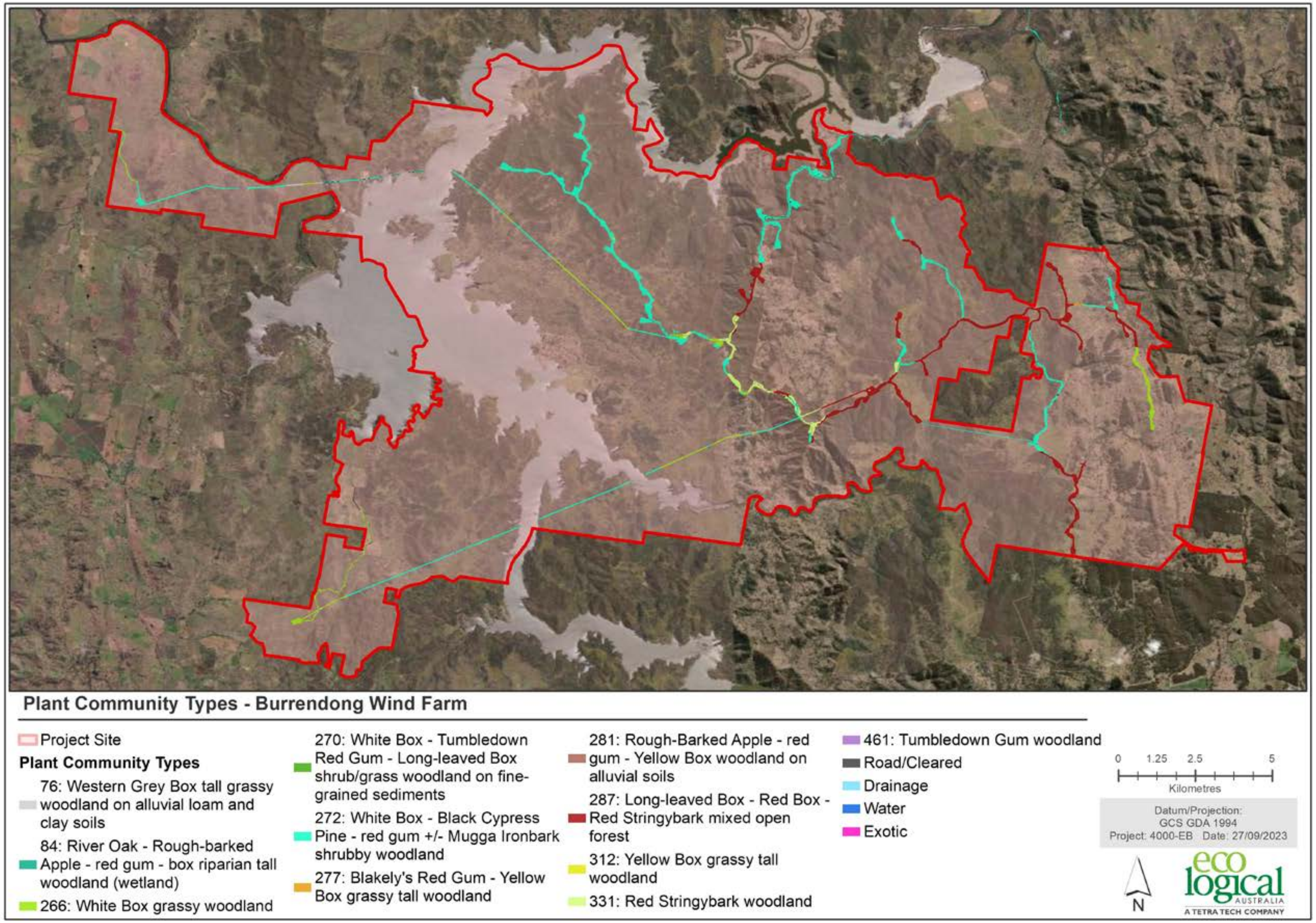


Figure 6-11: PCT mapping within the Project Site

Table 6-28: PCT descriptions within the Project Site

PCT	General Description	Description within Development Footprint	Photo
PCT 76 Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	Tall woodland to 25 m high dominated by Western Grey Box (*Eucalyptus microcarpa*) often as the only tree species often occupying 90% of the canopy cover. Found on undulating alluvial plains of south-central western NSW in the western section of the NSW South Western Slopes Bioregion.	This community occurs as a derived native grassland (DNG) with scattered trees. The Yarrabin Road Upgrade areas is in generally low DNG condition in comparison to the areas within the northern transmission line. There is 3.37 ha of PCT 76 in DNG condition within the Development Footprint.	
PCT 84 River Oak – Rough-barked Apple – red gum -box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion	Found on the banks of rivers and creeks in low hills and hills landforms of Nandewar and Brigalow Belt South Bioregions, characterised by tall woodland or open forests to 30 m high. Canopy is often dominated by *Casuarina cunninghamiana* subsp. *cunninghamiana* (River Oak) often with *Angophora floribunda* (Rough-barked Apple), *Eucalyptus camaldulensis* (River Red Gum), *Eucalyptus melliodora* (Yellow Box), *Eucalyptus blakelyi* (Blakely's Red Gum). A sparse mid storey may occur. In some places a "dry rainforest" lower tree/high shrub layer may occur. The ground cover can be dense or sparse and contains a rich flora of small shrubs, grasses, sedges and forbs.	This community was identified along watercourses, along stream channels and banks next to watercourses. The dominant tree was *Eucalyptus camaldulensis* with *Angophora floribunda*, *Casuarina cunninghamiana*, *Callitris glaucophylla* and *Eucalyptus blakelyi* also present. The midstorey was sparse but included *Acacia implexa*, *Phyllanthus gunnii*, *Dodonaea viscosa* and *Callistemon sieberi*. Ground cover contained a diverse array of native grasses and forbs with *Microlaena stipoides* as the dominant cover. *Panicum effusum*, *Urtica incisa*, *Cynodon dactylon*, and *Aristida ramosa* were also present.	

PCT	General Description	Description within Development Footprint	Photo
		There is community occurs in Good condition and as a DNG: • PCT 84_good (4.7 ha) • PCT 84_DNG (1.96)	
PCT 266 White Box grassy Woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion	Tall woodlands with trees to 25 m high dominated by *Eucalyptus albens* often as the only tree species. Shrub layer is usually sparse or absent depending on grazing history or soil type. The ground cover is usually mid-dense to dense except during drought and may be very diverse in grass and forb species. Very few areas contain a native ground cover with a rich flora. In heavily grazed sites fewer native species are present and the sites are dominated by *Austrostipa* spp, *Aristida* spp. and *Rytidosperma* spp.	This community was observed on undulating hills and hill slopes, where soils are more fertile. However, much of the community has been cleared with remnants of scattered old trees and a predominantly grazed understory. The dominant, tree species was *Eucalyptus albens*, with regenerating Brachychiton populneus within the area. The mid-storey was sparse to absent with *Acacia implexa*, *Lissanthe strigosa* and *Solanum cinereum* present at some locations. Ground cover contained a diverse array of native grasses and forbs including *Austrostipa scabra*, Bothriochloa macra, *Cheilanthes sieberi*, *Panicum effusum*, *Rytidosperma caespitosum* and *Aristida ramosa*, consistent with communities that have been subject to past gazing practices. Based on landscape position, species composition and the dominance of *Eucalyptus albens*, PCT 266 was considered the most appropriate plant community.	

PCT	General Description	Description within Development Footprint	Photo
		Three vegetation condition zones occurred within the Development Footprint for this PCT: • PCT 266_good (4.27 ha); • PCT 266_DNG (61.2 ha); and • PCT 266_low (22.9 ha)	
PCT 270 White Box – Tumbledown Reg Gum – Long-leaved Box shrub/grass woodland in fine-grained sediments of the upper Macquarie River Gorge, NSW central western slopes	Mid-high woodland dominated by *Eucalyptus albens* and *Eucalyptus dealbata* (Tumbledown Red Gum) with *Eucalyptus macrorhyncha* (Red Stringybark), and *Eucalyptus goniocalyx* (Long-leaved Box). Shrubs are sparse and include *Olearia elliptica* and *Cassinia laevis*. The ground cover is very sparse to mid-dense depending on rainfall and grazing. It includes the forb *Stypandra glauca* and the grasses *Themeda triandra* and *Rytidosperma pallidum*. Generally occurs on red clay soils on steep slopes and ridges composed of fine-grained sedimentary rocks such as shale and mudstone in mountain landscapes.	Within the Project Site, PCT 270 was found on ridgetops and hill slopes, where the dominant tree species were *Eucalyptus albens* and *Eucalyptus dealbata*, with *Brachychiton populneus*, *Eucalyptus macrorhyncha*, *Eucalyptus polyanthemos* (Red Box) and *Allocasuarina verticillata* present in small numbers. The midstorey included *Olearia elliptica* and *Dodonaea viscosa*. The ground cover contained a diverse array of native grasses and forbs including *Austrostipa scabra*, *Rytidosperma racemosum*, *Aristida ramose*, *Panicum effusum* with *Stypandra glauca*, *Themeda triandra* and *Rytidosperma pallidum* also present in small numbers.	 

PCT	General Description	Description within Development Footprint	Photo
		One condition class was identified within the Project Site, PCT 270_good	
PCT 272 White Box – Black Cypress Pine – red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes	Mid-high woodland containing *Eucalyptus albens*, *Callitris endlicheri* (Black Cypress Pine) with either *Eucalyptus dealbata* or *Eucalyptus blakelyi* and *Eucalyptus macrorhyncha* or occasionally *Eucalyptus sideroxylon* (Mugga Ironbark). Understorey contains a sparse shrub layer including wattles. Dense regenerating stands of *C. endlicheri* may be present in the understorey. The ground cover is sparse dominated by grasses such as *Rytidosperma racemosum* and *Austrostipa densiflora*. The rock fern *Cheilanthes sieberi* is often present. Occurs on brown clay loam or loam texture contrast soils.	PCT 272 forms the majority of the vegetation within the Development Footprint (404.41 ha) on upper slopes and ridges, mostly (294.45 ha) occurring within the Inland Slopes sub-region. PCT 272 was located mostly on the upper hill slopes and ridgetops, on a rocky substrate. The dominant tree species were *Eucalyptus albens*, *Callitris* sp. With smaller numbers of *Eucalyptus dealbata*, *Brachychiton populneus* and *Eucalyptus polyanthemos*. Midstorey is dominated by *Olearia elliptica*, with *Dodonaea viscosa*, *Lissanthe strigosa* and *Solanum* sp. Also present. The ground cover is sparse.	 

PCT	General Description	Description within Development Footprint	Photo
PCT 274 White Box – Rough-barked Apple alluvial woodland of the NSW central western slopes including in the Mudgee Region	Tall woodland dominated by Eucalyptus albens and *Angophora floribunda* with a sparse shrub cover including *Acacia buxifolia*, *Acacia implexa*, *Olearia elliptica*, *Hibbertia* spp. and *Swainsona galegifolia*. Ground cover may be dense in places and mid-dense overall. Forbs include *Acaena novae-zelandiae*, *Arthropodium milleflorum*, *Daucus glochidiatus* and *Arthropodium fimbriatum*; sedges include *Carex appressa*. Occurs on alluvial or colluvial red clay soils derived from shale in valley bottoms and on adjoining lower slopes in hill landscapes.	PCT 274 was found predominantly on sloped and in gullies close to drainage lines, within a hill's landform pattern. The area was dominated by *Eucalyptus albens* and *Angophora floribunda*, with *Brachychiton populneus* and *Eucalyptus melliodora*. The midstorey consisted of *Olearia elliptica*, *Acacia decora* and *Acacia implexa*. The ground layer was sparse with high litter cover with scattered *Dichondra repens*, *Geranium solanderi*, *Microlaena stipoides*, *Acaena novae-zelandiae* and *Themeda triandra*.	
PCT 277 Blakely's Red Gum – Yellow Box grassy tall woodland on the NSW South Western Slopes Bioregion	PCT 277 is characterised as a tall woodland to about 20 m high dominated by *Eucalyptus blakelyi* and *Eucalyptus melliodora*. Grading into areas with more *Eucalyptus bridgesiana*, *Eucalyptus goniocalyx* and rarely *Eucalyptus microcarpa*. Shrubs are sparse or absent and may include *Acacia dealbata*. The ground cover may be dense to sparse depending on rainfall and is dominated by grass species. Occurs on flats, foot slopes and hillslopes mainly in the upper slopes sub-region of the NSW South-western Slopes Bioregion. Mainly cleared and subjected to nutrification from fertilizers and associated weed invasion.	This PCT was observed on valley flats in a hill landform pattern, often grading into PCT 266 on the lower slopes. Eucalyptus melliodora was dominant with scattered *Eucalyptus albens* and *Eucalyptus blakelyi* and regenerating *Brachychiton populneus*. The mid-story was sparse but consisted of a small numbers of *Acacia implexa*, *Bursaria spinosa* and *Solanum cinereum*. Groundcover included species such *Aristida ramosa*, *Bothriochloa macra*, *Poa sieberiana*, *Rytidosperma caespitosum*, *Sida corrugata*, and *Vittadinia cuneata*.	

PCT	General Description	Description within Development Footprint	Photo
PCT 281 Rough-barked Apple – red gum – Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Tall open forest or woodland with trees up to 30 metres high dominated by *Angophora floribunda* usually with *Eucalyptus blakelyi* or *Eucalyptus melliodora*. Other tree species may include *Callitris glaucophylla*, *Brachychiton populneus*. Occurs on black, brown and grey alluvial and colluvial clay loam, loam or sandy loam soils derived from a range of substrates on valley flats and foot slopes in valleys in hill landform patterns mainly in the Brigalow Belt South Bioregion. Some areas also occur north of Mudgee in the Gulgong-Dunedoo area in the NSW South-western Slopes Bioregion.	This PCT was observed within the development footprint on alluvial plains and valley flats. The dominant species were *Angophora floribunda*, *Eucalyptus blakelyi*, *Eucalyptus melliodora* with regenerating *Brachychiton populneus*. There is no dominant mid-story present, with *Bossiaea heterophylla*, *Olearia elliptica* and *Solanum cinereum* present in low numbers. The groundcover was a mix of grasses and herbs, with *Aristida ramosa*, *Einadia nutans*, *Lomandra confertifolia*, *Swainsona galegifolia*, *Themeda triandra*, *Sporobolus creber*, *Panicum effusum* and *Bothriochloa macra* present. Overall 3.4 ha of PCT 281 occurs within the Development Footprint, all within the Inland Slopes sub-region, with 3.4 ha meeting the NSW listing of the TEC.	 
PCT 287 Long-leaved Box – red box – Red Stringybark mixed open forest on hills and hillslopes in the NSW South Western Slopes Bioregion	Mid-high to tall open forest or woodland to 25 m high dominated by *Eucalyptus goniocalyx*, *Eucalyptus polyanthemos* and *Eucalyptus macrorhyncha*. Contains a lower tree layer of *Callitris endlicheri* present at some locations. The mid storey is sparse. The ground layer is mid-dense. The rock ferns *Cheilanthes austrotenuifolia* and *Cheilanthes sieberi* are common along with Lomandra mat-rushes.	Overall 222.6 ha of PCT 287 occurs within the Development Footprint, all occurring within the Hill End sub-region. The majority of this PCT is located on the turbine footprint on the upper hillslopes and along ridge lines. This community was observed on upper hillslopes mostly on a rocky substrate. Dominant species included *Eucalyptus goniocalyx*, *Eucalyptus macrorhyncha* and *Eucalyptus*	

PCT	General Description	Description within Development Footprint	Photo
	Occurs on clayey soils derived from a range of substrates including granite, metamorphic rocks, fine-grained sedimentary and volcanic rocks on hillslopes.	*polyanthemos*. The midstorey was dominated by *Olearia elliptica*. Groundcover species included a mix of grasses and herbs such as *Themeda triandra*, *Poa sieberiana*, *Lomandra multiflora* and *Lomandra filiformis*.	
PCT 312 Yellow Box grassy tall woodland on valley flats in the upper slopes of the NSW South Western Slopes Bioregion and South Eastern Highlands Bioregion	Tall woodland or open forest dominated by Yellow Box (Eucalyptus melliodora) and generally lacking Blakey's Red Gum (*Eucalyptus blakelyi*). The shrub layer is very sparse or absent and if present may include *Acacia dealbata* or *Hibbertia obtusifolia*. The ground cover is mid-dense to dense and often dominated by grass species. Forbs include *Bulbine bulbosa* and *Senecio quadridentatus*. Climbers *Desmodium brachypodum* and *Desmodium varans* may occur. Occurs on either orange-brown deep podzolic soils derived from granite or brown loam-clays derived from metasediments or sedimentary rocks in valley floors and on footslopes slopes in the upper slopes sub-region of the NSW South Wales South-western Slopes Bioregion.	Overall, 0.5 ha of PCT 312 occurs within the Development Footprint on the Inland Slopes subregion. The area was dominated by Eucalyptus melliodora with an understory of native grasses including *Microlaena stipoides*, *Rytidosperma racemosum*, *Poa sieberiana* and *Austrostipa scabra*. Forbs included Geranium solanderi, *Hydrocotyle laxiflora*, *Veronica plebeia* and *Wahlenbergia gracilis*. The area was surrounded by PCT 272 and therefore this patch contained elements of this PCT such as *Olearia elliptica* and *Callitris endlicheri* present. The patch of PCT 312 was located on a sunken area of deep colluvial sediments in the upper slopes.	

PCT	General Description	Description within Development Footprint	Photo
PCT 331 Red Stringybark woodland on hillslopes, northern NSW South Western Slopes Bioregion	PCT 331 occurs on sandy loam soils derived from sandstone, siltstone or rhyolite substrates on exposed hill slopes in hill landform patterns as a mid-high woodland with trees to 20 m high dominated by *Eucalyptus macrorhyncha* with *Eucalyptus sideroxylon*, *Eucalyptus fibrosa* (Red Ironbark), *Eucalyptus blakelyi* or *Eucalyptus polyanthemos* subsp. *polyanthemos*. *Callitris endlicheri* (Black Cypress Pine) often forms a lower tree layer at about 8 m. The mid-storey may be dense or sparse and contains species such as *Grevillea floribunda*, *Acacia buxifolia*, *Harmogia densifolia*, *Acrotriche rigida*, *Brachyloma daphnoides*, *Hibbertia obtusifolia*, and *Calytrix tetragona*. Ground cover is sparse to very sparse and often there is a high litter cover or rock exposure. Species include *Lomandra filiformis*, *Aristida calycina*, *Rytidosperma pallidum*, *Astroloma humifusum*, *Cheilanthes sieberi*, *Goodenia hederacea*, and *Stypandra glauca*.	Overall 52.3 ha of PCT 331 occurs within the current development footprint with 1.5 ha occurring within the Inland Slopes sub-region. The majority of this PCT is located on upper hillslopes and ridgetops. Two vegetation zones of the community occurred within the Development Footprint: • PCT 331_Good (37.96 ha) • PCT 331_DNG (14.33 ha). PCT 331 was present on poor rocky soils on the upper slopes and ridgetops. The dominant tree species were *Eucalyptus macrorhyncha*, *Eucalyptus polyanthemos*, with Eucalyptus albens and *Eucalyptus goniocalyx*. The dominant mid-story was Olearia elliptica with a ground cover dominated by *Lomandra confertifolia* and *Stellaria pungens* in areas of good condition. In DNG area, grasses are dominant and include *Austrostipa scabra*, *Microlaena stipoides* and *Panicum effusum*. Forbs including *Cheilanthes sieberi* and *Oxalis perennans* are also present.	 

PCT	General Description	Description within Development Footprint	Photo
PCT 461 Tumbledown Gum woodland on hills in the northern NSW South Western Slopes Bioregion and southern Brigalow Belt South Bioregion	Mid-high to low open woodland to woodland dominated by Tumbledown Gum (*Eucalyptus dealbata*) often with no other tree species. Other trees that may be present include Kurrajong (*Brachychiton populneus* subsp. *populneus*), White Box (*Eucalyptus albens*), *Callitris endlicheri*, *Eucalyptus macrorhyncha* and *Eucalyptus sideroxylon*. The shrub layer is very sparse or absent. Tall shrubs include Acacia implexa and *Allocasuarina verticillata*. Low shrubs include *Acacia decora*, *Xanthorrhoea glauca* subsp. *angustifolia*, *Hibbertia obtusifolia*, *Calytrix tetragona*, *Brachyloma daphnoides*, *Pultenaea spinosa* and *Harmogia densifolia*. The ground cover is mainly composed of bare earth or stones with the vegetation cover very sparse to sparse depending on rainfall. Grass species include *Austrostipa scabra* subsp. *scabra*, *Austrodanthonia racemosa* var. *racemosa*, *Aristida personata*, *Aristida vagans*, *Poa sieberiana*, *Bothriochloa macra*, *Elymus scaber* var. *scaber* and *Panicum effusum*. Forb species include *Daucus glochidiatus*, *Stypandra glauca*, *Dic*hondra sp. A, *Einadia nutans* subsp. *nutans*, *Oxalis radicosa*, *Chamaesyce drummondii* and *Cymbonotus lawsonianus*. The rock ferns *Cheilanthes sieberi* and *Cheilanthes distans* are common as it the scrambler *Desmodium varians*. Occurs on shallow to stony brown to red sandy loam to light clay soils derived from metasediments or granite on hillslopes, hillcrests and gullies in rises, low hills and hills landform patterns mainly in the Gulgong – Dunedoo – Goolma – Tanner Springs region in the NSW South-western Slopes Bioregion with minor outliers to the north at the southern edge of the Brigalow Belt South Bioregion. Mostly cleared and overgrazed with some pasture weed infestation	One vegetation zone of the community occurred within the Development Footprint to a total of 2.08 ha in good condition partially along the Yarrabin Road Upgrade area. There was also a patch of 461_Good within the Northern Transmission Line. PCT 461 was present on poor rocky soils along the Yarrabin Road Upgrade area. The dominant tree species were Eucalyptus dealbata with *Brachychiton populneus* and *Callitris glaucophylla*. The shrub layer was mainly absent. The ground layer was dominated by *Aristida ramosa* and *Austrostipa scabra* with a variety of scattered forbs.	 

6.5.1.4. Threatened Ecological Communities

Of the twelve (12) PCTs that occur within the Development Footprint, seven (7) PCTs are associated with threatened ecological communities (TECs) listed under the BC Act and EPBC Act. The majority of the Project Site is vegetated with non-TEC PCTs (84%). Six PCTs are associated with one TEC. TECs within the Development Footprint have been summarised below and in Table 6-29, and presented in Figure 6-12:

- **PCT 76**: Conforms to a TEC listed under the BC Act and EPBC Act
- **PCT 266, 270, 274, 277, 281 and 312**: 111 ha associated with the TEC White Box Yellow Box Blakely's Red Gum Woodland and Derived Native Grassland listed as critically endangered (CE) under the BC Act. The majority of these PCTs do not meet the criteria for listing under the EPBC Act due to a degraded understorey lacking sufficient cover or native species diversity.

Table 6-29: TECs listed under the BC Act and EPBC Act

PCT ID	BC Act			EPBC Act		
	Listing Status	Name	Area (ha)	Listing Status	Name	Area (ha)
76	CE (Part)	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregion	3.37	CE (Part)	Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	3.37
266		White-Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	88.4	CE (Part)	White-Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	10.8
270	CE (Part)	White-Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	0.13	CE (Part)	White-Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	0.13
274	CE (Part)	White-Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	1.15	CE (Part)	White-Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	0 (Does not conform)
277	CE (Part)	White-Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	17.5	CE (Part)	White-Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	1.3
281	CE (Part)	White-Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	3.4	CE (Part)	White-Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	0 (Does not conform)
312	CE (Part)	White-Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	0.5	CE (Part)	White-Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	0.5
TOTAL			**111**			**16.1**

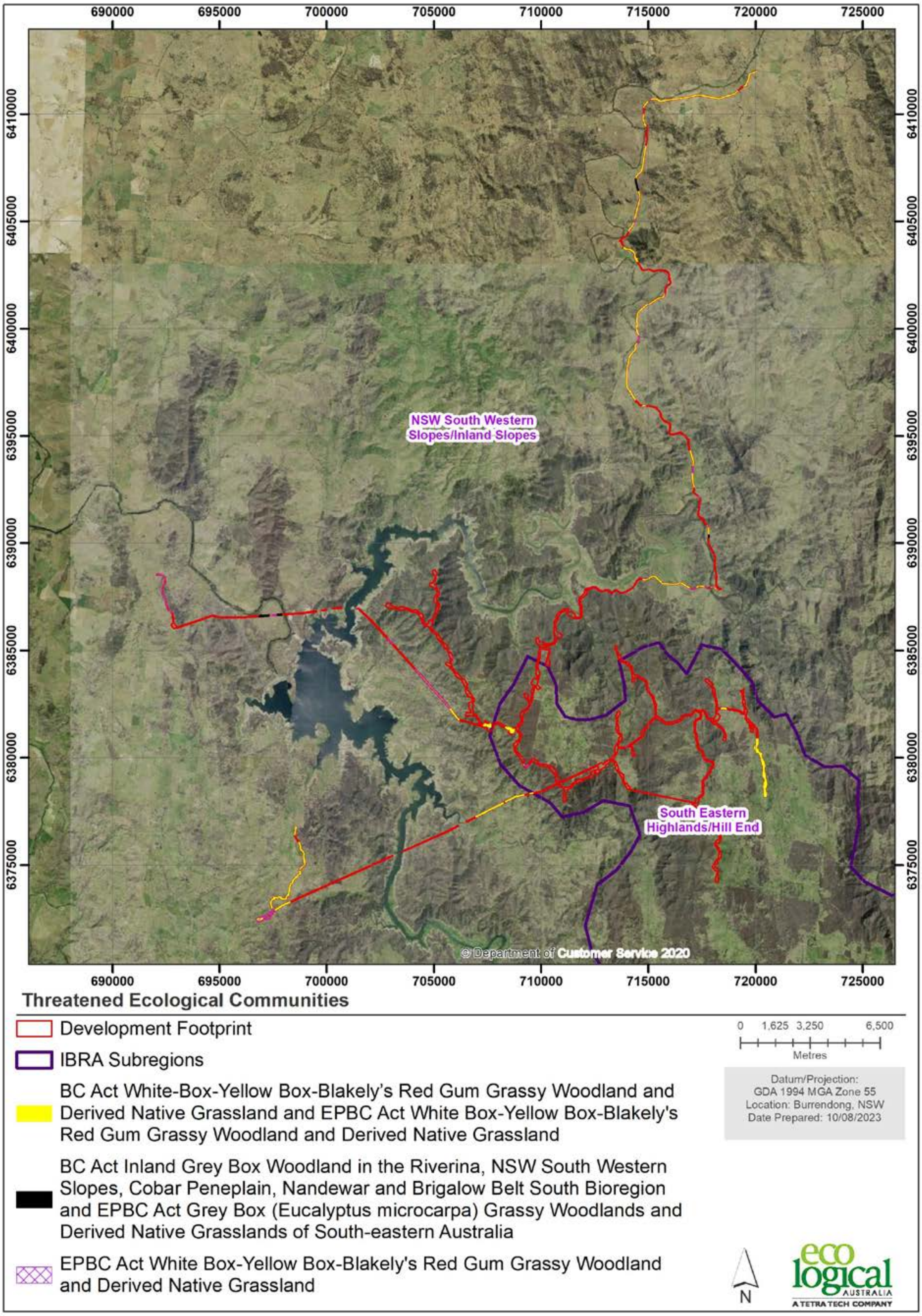


Figure 6-12: TECs within the Project Site

6.5.1.5. Threatened Species

In accordance with the BAM, the threatened species outlined in Table 6-30 required detailed consideration during preparation of the BDAR (ELA 2023). Subsections 5.2.1 to 5.2.6 of the BAM were used to identify the habitat suitability for threatened species within the Project Site. Table 6-30 outlines species credit species that required further assessment (i.e., targeted surveys with reference to the appropriate guidelines, where guidelines exist) on the Development Footprint, their associated habitat constraints, and geographic limitations, as well as justification for excluding those species which are considered vagrant, or unlikely to occur in the habitats available within the Project Site.

Based on an assessment of habitat constraints, geographic limitations, and site degradation, the following species have been considered for further assessment:

FAUNA

- *Aprasia parapulchella* (Pink-tailed Legless Lizard)
- *Burhinus grallarius* (Bush Stone Curlew)
- *Callocephalon fimbriatum* (Gang-gang Cockatoo)
- *Calyptorhynchus lathami* (Glossy Black-Cockatoo)
- *Cercartetus nanus* (Eastern Pygmy-possum)
- *Haliaeetus leucogaster* (White-bellied Sea-Eagle)
- *Hoplocephalus bitorquatus* (Pale-headed Snake)
- *Hamirostra melanosternon* (Black-breasted Buzzard)
- *Hieraaetus morphnoides* (Little Eagle)
- *Keyacris scurra* (Key's Matchstick Grasshopper)
- *Lophochroa leadbeateri* (Major Mitchell's Cockatoo)
- *Lophoictinia isura* (Square-tailed Kite)
- *Ninox connivens* (Barking Owl)
- *Ninox strenua* (Powerful Owl)
- *Petaurus norfolcensis* (Squirrel Glider)
- *Phascogale tapoatafa* (Brush-tailed Phascogale)
- *Phascolarctos cinereus* (Koala)
- *Polytelis swainsonii* (Superb Parrot)
- *Tyto novaehollandiae* (Masked Owl)

FLORA

- *Acacia ausfeldii* (Ausfeld's Wattle)
- *Austrostipa wakoolica* (Spear-grass)
- *Dichanthium setosum* (Blue Grass)
- *Diuris tricolor* (Pine Donkey Orchid)
- *Eucalyptus alligatrix* subsp. *alligatrix*
- *Euphrasia arguta*
- *Grevillea divaricata*
- *Indigofera efoliata* (Leafless Indigo)
- *Pomaderris cotoneaster* (Cotoneaster Pomaderris)
- *Pomaderris queenslandica* (Scant Pomaderris)

- *Swainsona recta* (Small Purple-pea)
- *Swainsona sericea* (Silky Swainson-pea)
- *Tylophora linearis*

All other species have been excluded from assessment as described in Table 6-30.

Table 6-30: Predicted species credit species and justification for exclusion

Species	Common Name	Habitat Constraints	Sensitivity to gain class	NSW listing status	EPBC Listing status	Presence of habitat on site	Action
Acacia ausfeldii	Ausfelds Wattle	Footslopes and low rises on sandstone	High	V	NL	Associated with PCT 277, 281, 272 and 266 on footslopes and low rises on sandstone. Habitat within the Project Site.	Survey required and undertaken
Acacia phasmoides	Phantom Wattle		Moderate	V	V	Outside of the species geographical range. Occurs East of Albury.	No survey required
Ammobium craspedioides	Yass Daisy		High	V	V	Outside of the species geographical range. Occurs South of Cowra.	No survey required
Anthochaera phrygia	Regent Honeyeater (Breeding)	As per mapped areas	High	CE	CE	Areas are not within important mapped areas.	No survey required
Aprasia parapulchella	Pink-tailed Legless Lizard	Rocky Areas or within 50 m of rocky areas	High	V	V	Associated with PCT 331, 277, 274, 270, 266. With a predominantly grassy ground layers with partially buried rocks, in association with *Themeda triandra*. Potential habitat within the Development Footprint.	Survey required during micro-siting
Austrostipa wakoolica	Spear-grass	Alluvial plains	Moderate	E	E	Likely to be outside of the species geographical range. Occurs west of Cowra.	Searches were undertaken in PCT 76 along the Northern transmission line
Burhinus grallarius	Bush Stone-curlew	Fallen / standing dead timber including logs	High	E	NL	Areas of fallen timber within the Project Site.	Survey required and undertaken
Caladenia arenaria	Sand-hill Spider Orchid		Moderate	E	E	Occurs in woodlands with sandy soils. No suitable habitat within the Development Footprint.	Survey not required.
Callocephalon fimbriatum	Gang-gang Cockatoo (Breeding)	Hollow bearing trees. 9 cm diameter	High	V	NL	Suitable hollow bearing trees present.	Survey required and undertaken

Species	Common Name	Habitat Constraints	Sensitivity to gain class	NSW listing status	EPBC Listing status	Presence of habitat on site	Action
Calyptorhynchus lathami	Glossy Black-Cockatoo (Breeding)	Hollow bearing trees. 15 cm diameter	High	V	NL	Suitable hollow bearing trees present.	Survey required and undertaken
Cercartetus nanus	Eastern Pygmy-possum		High	V	NL	Suitable hollow bearing trees with a shrubby understorey present.	Survey required and undertaken in areas of high quality habitat in accordance with advice from the species expert
Chalinolobus dwyeri	Large-eared Pied Bat	Cliffs. Within 2 km of rocky areas containing caves, mines etc	Very High	V	V	No suitable habitat on site.	No surveys required
Crinia sloanei	Sloane's Froglet	Semi-permanent / ephermeral wetlands with submergent vegetation	Moderate	V	E	No suitable habitat within the Development Footprint as dams lack emergent vegetation. Potential to be within the broader Project Site.	Surveys required and undertaken
Cullen parvum	Small Scurf-pea		High	E	NL	Associated with PCT 277. These areas within the Project Site have been extensively grazed with high weed cover which are an identified threat to this species. Habitat is deemed to be degraded. No individuals have been found in the general locality with populations being recorded well south of the Project Site, near Albury, Wagga Wagga Jerilderie and across the Victoria border.	No survey required
Delma impar	Striped Legless Lizard		Moderate	V	V	Associated with PCT 274 and 277. No individuals have been found in the general locality with populations being recorded well east of the Project Site, near Muswellbrook, Tumut Cooma and Yass and across the Victoria and ACT borders. Unlikely to occur within the Development Footprint.	No survey required

Species	Common Name	Habitat Constraints	Sensitivity to gain class	NSW listing status	EPBC Listing status	Presence of habitat on site	Action
Dichanthium setosum	Bluegrass		High	V	V	Associated with PCT 281 on fertile soils. Suitable habitat present.	Survey required and undertaken
Diuris tricolor	Pine Donkey Orchid		Moderate	V	NL	Associated with PCT 331. Suitable habitat is present within the Project Site.	Survey required during micro-siting
Eucalyptus alligatrix subsp. *Alligatrix*	Eucalyptus alligatrix		High	V	V	Associated with PCT 331, 287, Suitable habitat is present within the Project Site.	Survey required and undertaken
Euphrasia arguta	Euphrasia arguta		High	CE	CE	Associated with PCT 84, 266, 281, 277, 287, 272, 270. Suitable habitat is present within the Project Site.	Survey required during micro-siting
Grevillia divaricata	Grevillia divaricata		High	E	NL	This species has not been seen since 1823. Known only from type collection north of Bathurst. Very little is known but is associated with PCT 331, 270. Potential habitat within the Project Site although unlikely.	Survey required during micro-siting
Grevillea wilkinsonii	Tumut Grevillea		High	CE	E	The Tumut Grevillea has a highly restricted distribution located along a 6km stretch of the Goobarragandra River 20 km east of Tumut and a small population at Gundagai. This species is restricted to riparian vegetation associated with PCT 266. No suitable habitat exists and it is outside of the species geographical range.	No Survey required
Haliaeetus leucogaster	White-bellied Sea Eagle (Breeding)	Living or dead mature trees within suitable vegetation within 1 km of water	High	V	NL	Associated with PCT 84, 277, 281, 287. Suitable habitat is present within the Project Site.	Survey required and undertaken.
Hamirostra melanosternon	Black-breasted Buzzard (Breeding)	WaterbodiesLand within 40m of riparian woodland containing stags	Moderate	V	NL	Associated with PCT 84. Suitable habitat is present within the Project Site however the species is associated with inland areas <500 m rainfall so this species is unlikely to be present.	Survey undertaken

Species	Common Name	Habitat Constraints	Sensitivity to gain class	NSW listing status	EPBC Listing status	Presence of habitat on site	Action
Hieraaetus morphnoides	Little Eagle (Breeding)	Nest trees – large old trees	Moderate	V	NL	Associated with all PCTs within the Project Site. Suitable habitat is present within the Project Site.	Survey required and undertaken
Hoplocephalus bitorquatus	Pale-headed Snake		High	V	NL	Associated with PCT 84 and within 500 m of moderate to good habitat. Habitat is degraded and unlikely to support the species.	Survey not required
Indigofera efoliata	Leafless Indigo		High	E	E	Associated with PCT 76 in association with Allocasuarina luehamannii and Exocarpus cupressiformis. Suitable habitat is unlikely to exist within the Development Footprint.	Surveys undertaken outside of ideal survey timing but no similar species was potentially identified
Keyacris scurra	Key's Matchstick		High	E	NL	Associated with PCT 266 with *Themeda* and *Asteraceaes*.	Unlikely but habitat may exist along TL-northern option
Lathamus discolor	Swift Parrot (Breeding)	As per mapped areas	Moderate	E	CE	Not within mapped areas	No surveys required
Litoria booroolongensis	Booroolong Frog		High	E	E	Associated with PCT 84, 277, 281, 287, and 331 within permanent streams with fringing vegetation and rocky cobble banks. Permanent streams were not present within the Project Site. Unlikely to occur as only found within permanent streams north east of Lithgow. However, streams were investigated.	Surveys not required; however a preliminary assessment was undertaken whilst out spotlighting.
Lophochroa leadbeateri	Major Mitchell's Cockatoo (Breeding)	Hollow bearing trees. Hollows > 10 cm diameter	High	V	NL	Associated with PCT 84 and 331. Suitable hollow bearing trees present.	Survey required and undertaken
Lophoictinia isura	Square-tailed Kite (Breeding)	Nest trees	Moderate	V	NL	Associated with all PCTs across the Project Site. Suitable hollow bearing trees present.	Survey required and undertaken

Species	Common Name	Habitat Constraints	Sensitivity to gain class	NSW listing status	EPBC Listing status	Presence of habitat on site	Action
Miniopterus orianae oceansis	Large Bent-winged bat (Breeding)	Caves, tunnels, mines	Very High	V	NL	There are no caves, tunnels, mines or culverts that could be used for breeding within the Project Site. No suitable habitat on site.	No surveys required
Ninox connivens	Barking Owl (Breeding)	Hollow bearing trees. 20 cm diameter	High	V	NL	Associated with all PCTs within the Project Site. Suitable hollow bearing trees present.	Survey required and undertaken
Ninox strenua	Powerful Owl (Breeding)	Hollow bearing trees. 20cm diameter	High	V	NL	Associated with PCT 84, 281, 287. Suitable hollow bearing trees present.	Survey required and undertaken
Persoonia marginata	Clandulla Geebung		High	V	V	Associated with PCT 287. Only found between Kandos to Clarence in the Blue Mountains. Unlikely to be within the Development Footprint.	Survey required and undertaken
Petauroides volans	Southern Greater Glider	Hollow bearing trees with large hollows (Lindenmayer et al 1991)	High	NL	V	Associated with PCT 270. Unlikely to occur within this PCT as the species is often associated with taller moist eucalypt forests with abundant hollows. The trees within this PCT are all small (average DBH 20 cm) with small hollows (5 cm). Habitat is marginal at best.	No surveys required.
Petaurus norfolcensis	Squirrel Glider		High	V	NL	Associated with all PCTs within the Project Site. Suitable hollow bearing trees present.	Survey required and undertaken
Petaurus norfolcensis – endangered population	Squirrel Glider in the Wagga Wagga LGA	Wagga Wagga LGA	High	E	NL	Outside of the species geographical range.	No survey required
Petrogale penicillata	Brush-tailed Rock Wallaby	Land within 1 km of rocky escarpment, cliff lines, outcrops and gorges	Very High	E	V	Occupies rocky escarpments, outcrops and cliffs. There are no suitable habitat features within the Project Site.	No survey required

Species	Common Name	Habitat Constraints	Sensitivity to gain class	NSW listing status	EPBC Listing status	Presence of habitat on site	Action
Phascogale tapoatafa	Brush-tailed Phascogale		High	V	NL	Associated with PCT 266, 272, 277, 281, 331 and 461. Suitable hollow bearing trees present.	Survey required and undertaken
Phascolarctos cinereus	Koala (Breeding)	Areas identified as important habitat	High	V	V	Associated with all PCTs within the Project Site. Known to occur within the Project Sites.	Survey required and undertaken
Polytelis swainsonii	Superb Parrot (Breeding)	Hollow bearing trees (*E. blakelyi, E. melliodora, E. albens, E. polyanthemus*). Hollows greater than 5 cm diameter in trees greater with DBH > 30cm.	High	V	V	Associated with all PCTs within the Project Site except PCT 287. Known to occur within the Project Site.	Survey of suitable HBT is required and will be undertaken during micro-siting
Pomaderris cotoneaster	Cotoneaster Pomaderris		High	E	E	Recorded in a range of habitats in forested country. Suitable habitat along rocky forested slopes.	Surveys undertaken. No individuals likely to be this species has been identified. Unlikely to occur.
Pomaderris queenslandica	Scant Pomaderris		High	E	NL	Associated with PCT 84 on sandy loam associated with sandstone or conglomerate. Within the Sydney Basin. Suitable habitat is present within the Project Site.	Survey required and undertaken. No individuals likely to be this species has been identified. Unlikely to occur.
Prasophyllum petilum	Tarengo Leek Orchid	East of Binalong, South and east of Boorowa	High	E	E	Associated with PCT 277 and 281 on fertile soils within open woodlands and DNG. It occurs in moist area where the water Table is high and standing free water resides for up to 24 hrs after storms. Associated with *Schoenus apogon, Drosera peltata* and *Haloragis heterophylla* confirming that the site	No survey required

Species	Common Name	Habitat Constraints	Sensitivity to gain class	NSW listing status	EPBC Listing status	Presence of habitat on site	Action
						is poorly drained. No suitable habitat exists within the Development Footprint.	
Prasophyllum sp, Wybong	Prasophyllum Wybong		Moderate	NL	CE	NSW does not consider this a separate species from the above.	No survey required
Pteropus poliocephalus	Grey-headed Flying Fox (Breeding)	Breeding camps	High	V	V	Associated with all PCTs within the Project Site. Breeding / roost camps are generally found in gullies, close to water and in vegetation with a dense canopy. No breeding camps identified.	No survey required
Pultenaea humilis	Dwarf Bush-pea		High	V	NL	Associated with PCT 287. Within NSW it is currently known from 3 localities south of Tumut and closer to the Act and Victorian boarders. Considered to be outside of the species geographical range.	No survey required
Senecio garlandii	Woolly Ragwort		Moderate	V	NL	Associated with PCT 287. The species is found between Temora, Bethungra, Albury and Yass. It occurs on sheltered slopes of rocky outcrops. No suitable habitat within the Project Site and likely to be outside of the species geographical range.	No survey required
Swainsona recta	Small Purple-pea		Moderate	E	E	Associated with PCT 266, 270, 277 usually in association with *Themeda australis*. Suitable habitat is present within the Project Site.	Survey required and will be undertaken during micro-siting
Swainsona sericea	Silky Swainson-pea		Moderate	E	E	Associated with PCT 266, 277, and 281 within Box-Gum Woodland. Suitable habitat is present within the Project Site.	Survey required and will be undertaken during micro-siting
Synemon plana	Golden Sun Moth	Wallaby Grass	Moderate	E	CE	Associated with PCT 266 and 277. The species historical distribution extends south and east of Bathurst through Yass plains and through central and western Victoria. No records have been listed further north of Bathurst. Outside of the species geographical range. No areas of	No survey required

Species	Common Name	Habitat Constraints	Sensitivity to gain class	NSW listing status	EPBC Listing status	Presence of habitat on site	Action
						Rytidosperma sp. with bare ground for female display sites (O'Dwyer and Attiwill 1998).	
Tylophora linearis	Tylophora linearis		High	V	E	Associated with PCT 272. Suitable habitat is present within the Project Site.	Survey required and will be undertaken during micrositing
Tyto novaehollandiae	Masked Owl (Breeding)	Hollow bearing trees. 20 cm diameter	High	V	NL	Suitable hollow bearing trees present.	Survey required and undertaken
Vespadelus troughtoni	Eastern Cave Bat	Cliffs. Within 2 km of rocky areas containing caves, mines etc	Very High	V	NL	No suitable habitat exists on site. There are no caves, cliffs or overhangs within 2km of the Project Site. Associated with PCT 84, 274 Breeding habitats are areas within 100 m of caves/ over hangs.	No survey required
Zieria obcordata	Granite Zieria	Rocky areas containing granite boulders or rocky outcrops	High	E	E	Associated with 287 and 272 dominated by *Acacia* on rocky hillsides among granite boulders ranging in altitude between 500-800 m. No suitable habitat is within the Project Site as there are no granite boulders.	No survey required

THREATENED FLORA

Potential habitat for threatened flora is present within DNG and woodland areas within the Project Site. No threatened flora species were recorded within the Project Site, however records of *Acacia ausfeldii*, *Dichanthium setosum*, *Eucalyptus cannonii* (Capertee Stringybark), *Swainsona recta* and *Swainsona sericea* occur within 10 km of the Project Site, with most records occurring near to the eastern route road upgrade. Following subsequent Project design, the eastern route road upgrade area has now been excluded from the Project Site. Therefore, impacts to potential habitat for threatened flora occurring within the amended Project Site is unlikely to occur. Transects were completed in DNG areas across 47 ha, walking along the transect 10 m apart on the Southern Transmission Line. The target species for this survey were:

- *Tylophora linearis*
- *Euphrasia arguta*
- *Pomaderris queenslandica*
- *P. cotoneaster*
- *Eucalyptus alligatrix*
- *Dichanthium setosum*
- *Acacia ausfeldii.*

Due to the large area under investigation targeted flora surveys using parallel transects of less than 5 m was not undertaken and not all areas were able to be investigated in accordance with the threatened species guidelines. Instead, areas of potential habitat were surveyed whilst undertaking vegetation integrity plots, rapid assessments and whilst undertaking vegetation mapping. No threatened flora species were observed. Habitat surveys were undertaken outside the ideal survey period for the following species, and they are assumed to be present across all sections within their associated PCTs across the entire footprint until further surveys are conducted:

- *Diuris tricolor*
- *Swainsona recta*
- *Swainsona sericea*
- *Aprasia parapulchella*

Surveys across the Transmission Line – Northern option were not completed during the required survey timing for many species. This option was initially rejected due to the presence of CEEC; however, this option is now being reconsidered. Some species have also been recently included due to updates made to the BAMC, i.e., *Keyacris scurra*. The following flora are assumed present in the northern option until additional surveys can be completed:

- *Euphrasia arguta*
- *Tylophora linearis*

Due to changes made to the Development Footprint within the Road Upgrade areas, surveys were not undertaken for *Austrostipa wakoolica* during the required survey period and therefore credits have also been calculated for these species.

No threatened flora species were observed during survey. Threatened flora survey effort is presented in Figure 6-13. Species polygons for threatened flora assumed present are provided in Figure 6-14, Figure 6-15 and Figure 6-16.

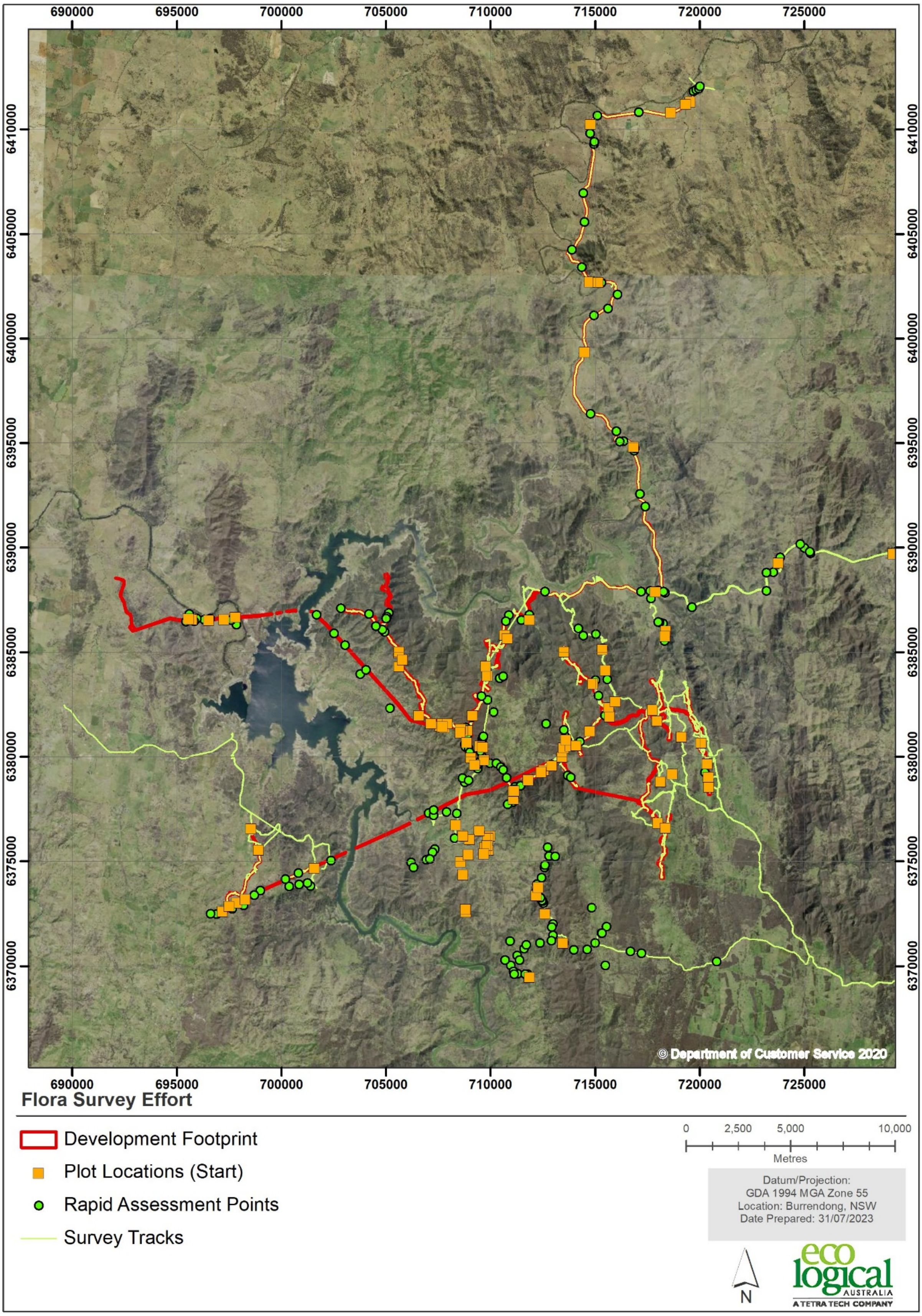


Figure 6-13: Targeted flora surveys

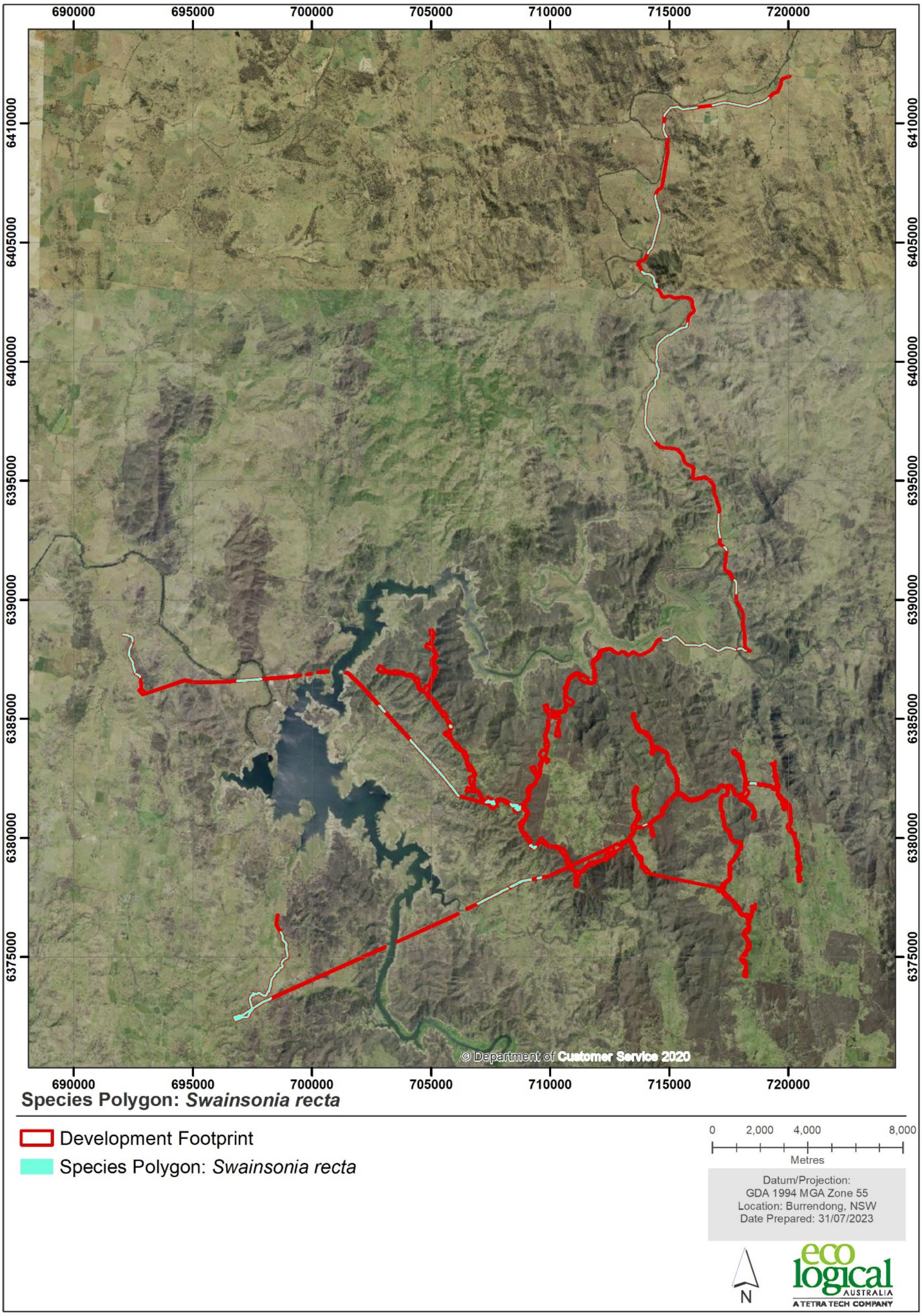


Figure 6-14: Species polygon *Swainsona recta*

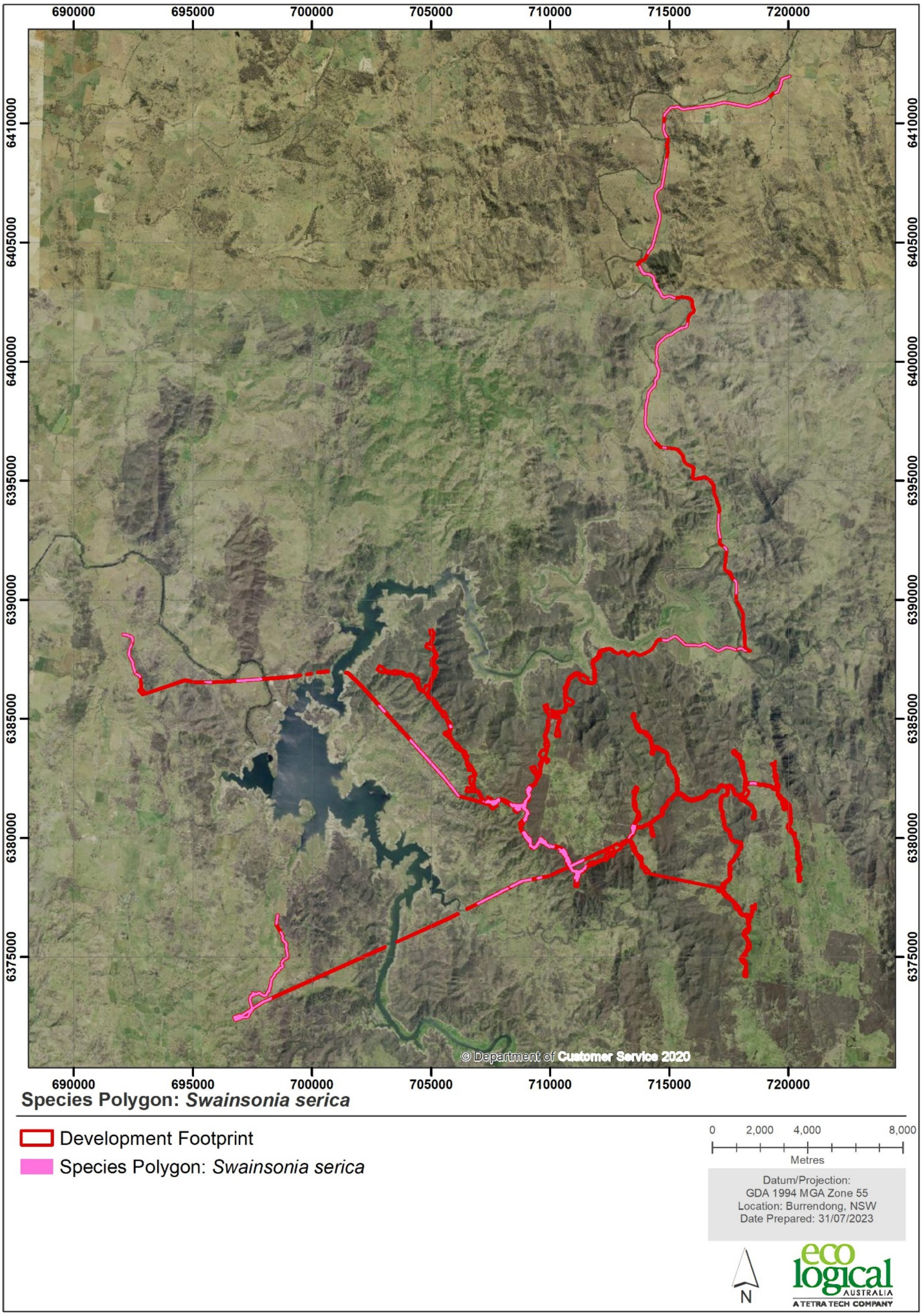


Figure 6-15: Species polygons *Swainsona sericea*

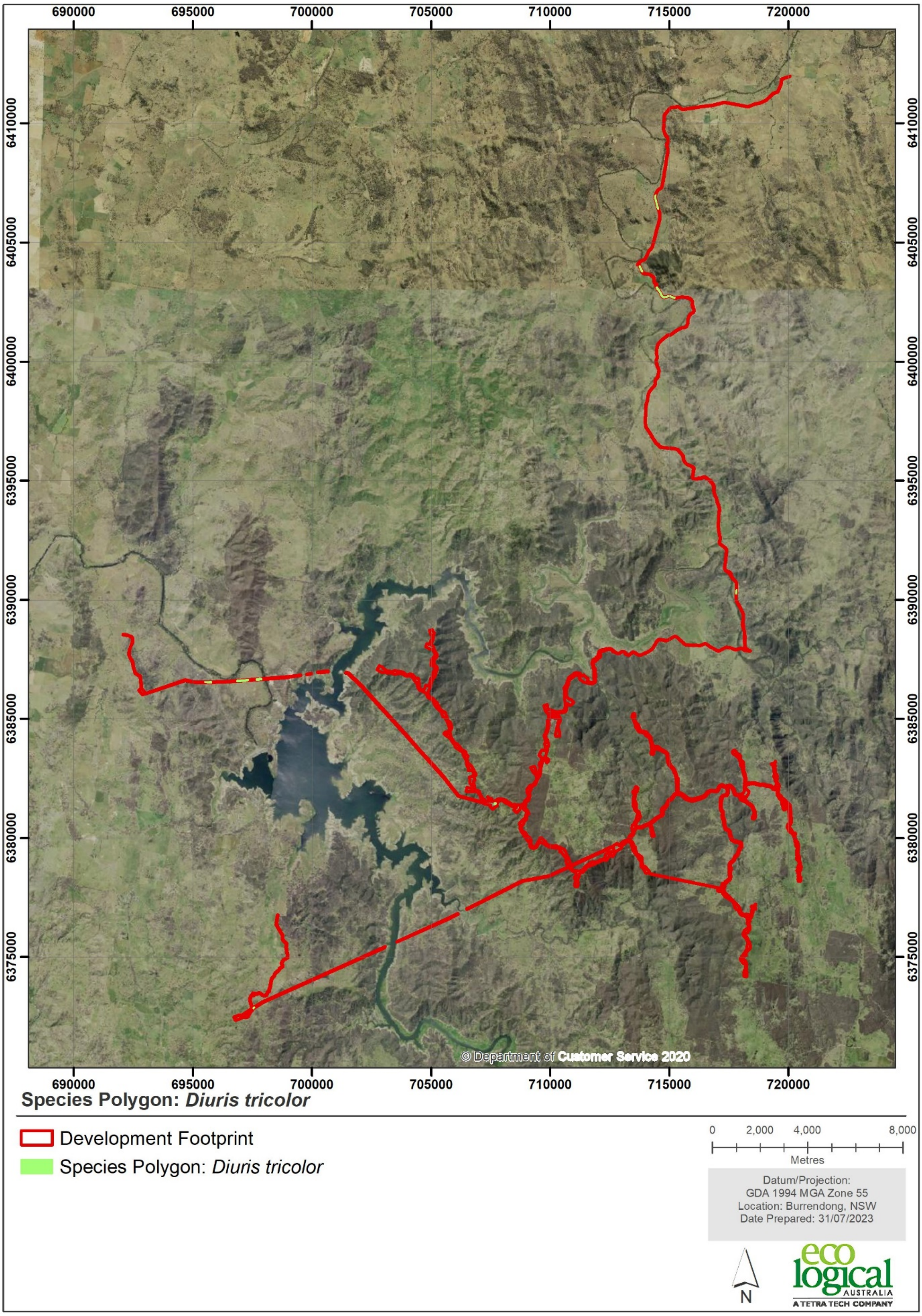


Figure 6-16: Species polygon *Diuris tricolor*

THREATENED FAUNA

Fauna survey methods and results are described below. Survey effort is presented in Figure 6-17 and results are presented in Figure 6-18. Due to changes made to the development footprint within the Road Upgrade areas, surveys were not undertaken for *Phascogale tapoatafa* (Brush-tailed Phascogale) during the required survey period and therefore credits have also been calculated for these species.

DIURNAL BIRDS

Bird surveys were undertaken using the 20 min / 2 ha search method over December 2020, January 2021, August 2021, September 2021, October 2021, and June 2021 at 11 locations targeting areas that represent the highest quality and most connected habitat, including road reserves, and along creek lines. All species heard and observed were recorded. Each site was visited at least twice, morning and evening. Surveyors also recorded opportunistic sightings throughout other surveys and whilst traversing the site. Bird surveys were also undertaken at an additional 16 locations (same location as bird utilisation surveys, see below) on five separate occasions resulting in a total of 109 bird surveys across the Project Site over a twelve-month period.

Searches for large stick nests such as those used by raptors such as White-bellied Sea Eagle, Square-tailed Kite and Little Eagle were undertaken across the Project Site during vegetation surveys and bird surveys. One White-bellied Sea Eagle was recorded opportunistically on 26 Jan 2023 by Senior Ecologist Cheryl O'Dwyer. This individual was flying around the dam. One Little Eagle was observed flying above the open paddock whilst travelling along Burrendong Dam Road. No other candidate diurnal avifauna species or evidence of their breeding (i.e., large stick nests) were observed during the surveys.

BIRD UTILISATION SURVEY (BUS)

A minimum of 16 sites were surveyed across the Project Site with each visited on at least five separate occasions incorporating morning (early and mid) and afternoon surveys (mid and late). All birds flying at turbine rotor height were recorded and the flight height and flight path recorded to identify any species (threatened or common) that may be impacted by blade strike. Diurnal bird surveys were also undertaken at the same time. A total of 87 BUS surveys were undertaken.

There is a known population of Superb Parrots that are consistently observed along 12 Mile Rd near Wellington which reside within *Eucalyptus melliodora*. No individuals were observed within the Project Site, however suitable habitat trees should be investigated during micro-siting.

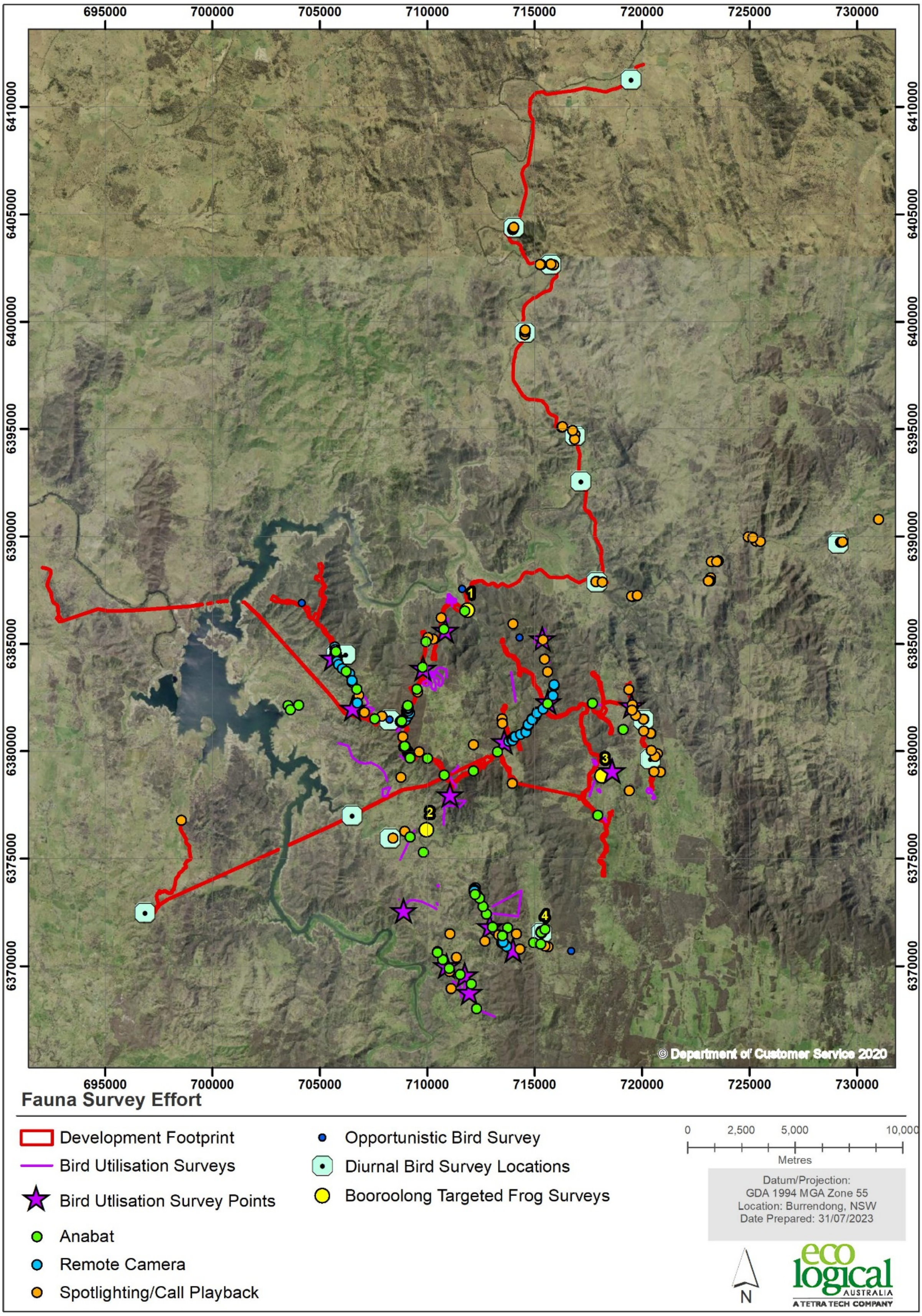


Figure 6-17: Targeted fauna survey effort

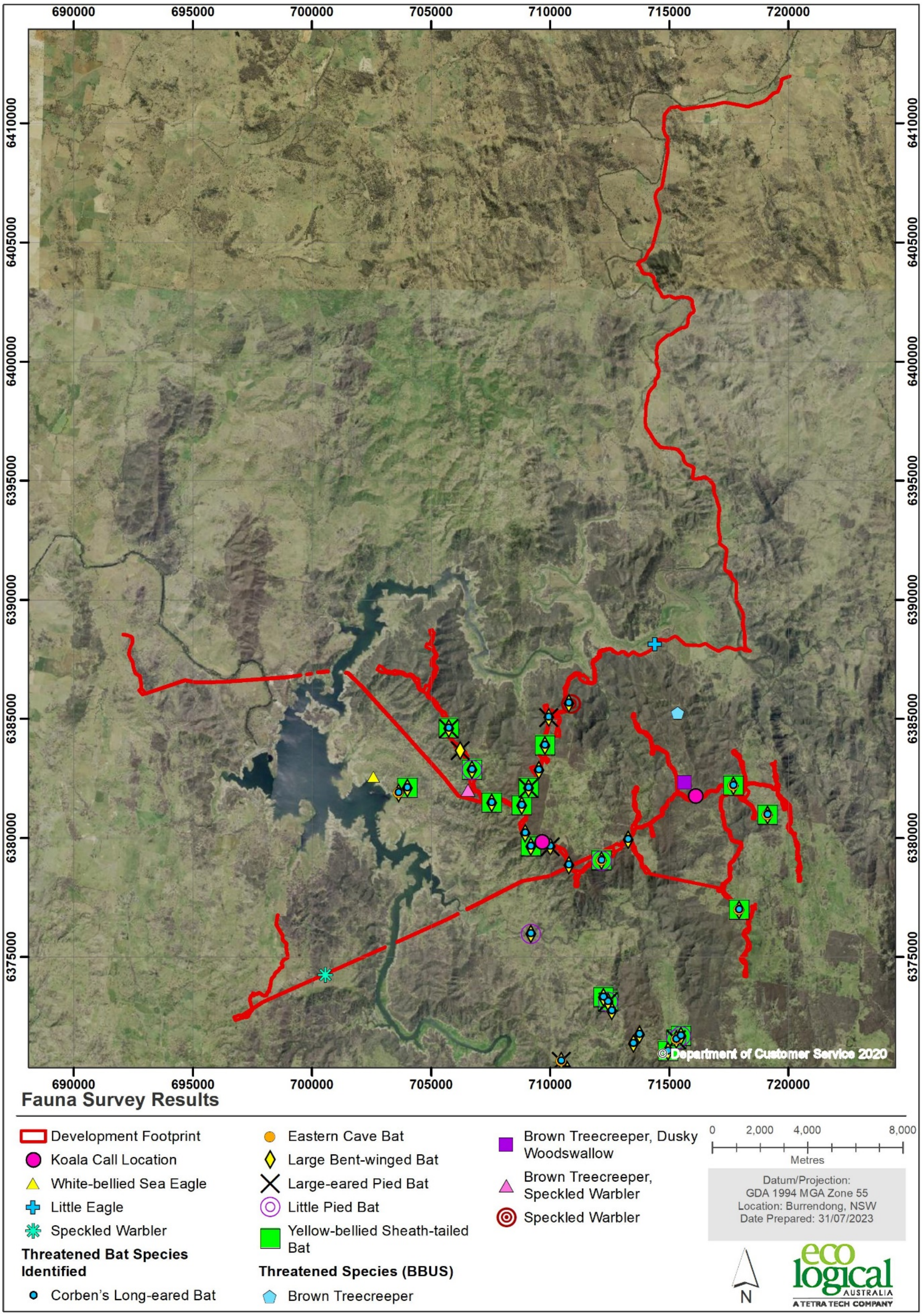


Figure 6-18: Targeted fauna survey results

SPOTLIGHTING / CALL PLAYBACK

Daytime searches were conducted on foot during daylight hours to locate roosts, feed trees, hollows, or nest sites to identify suitable habitat for the following species:

- Koala
- Squirrel Glider
- Eastern Pygmy Possum
- Brush-tailed Phascogale
- Bush Stone Curlew
- Barking Owl
- Powerful Owl
- Masked Owl.

No signs of owl roosts such as faeces and owl pellets were recorded. Nocturnal surveys including spotlighting and call playback were conducted over Sixteen nights (19-20, 24-27 August 2020, 15-26 August 2021) at fifteen locations and again on 2-12 August 2021 (eight nights) along ten locations along access roads. Playback sequence included calls of the three owl species, Koala and Bush Stone Curlew. A total of 288 spotlighting hours were undertaken across the Project Site.

No threatened birds were seen or heard during the August 2020, December 2020 and August 2021 nocturnal call playback survey. Tawny Frogmouth, Boobook Owl and Owlet Nightjar were observed during spotlighting. Common Ringtail possum and Common Brushtail possum were regularly observed within the Project Site. An unidentified glider (*Petaurus* sp.) was observed briefly but due to its size it was most likely *P. breviceps* (Sugar glider). This result was further supported from camera traps with all the images of gliders identified as *P. breviceps*. Feathertail Glider was also observed. None of the images were identified as being threatened species Eastern Pygmy Possum, Brush-tailed Phascogales, or Squirrel Gliders.

Figure 6-19: *Petaurus breviceps* (Sugar Glider) captured on camera trap

During call playback a feint reply call of a male koala was heard. A male was also heard calling during a subsequent site visit during call playback. Given the recent sightings in the broader landscape, i.e., at Grattai, World's End, along Hill End Road and surrounds, it is likely that koalas are present, although in small numbers. Species credits have been calculated for this species.

AMPHIBIANS

Spotlighting and call playback were also undertaken for the Booroolong Frog in rocky waterways at three locations during the evening of the 16 and 17 December 2020. Water had pooled in creeks after recent rains but due to lack of flowing permanent water, habitat for Booroolong Frog was considered marginal at best. No calls were heard during call playback.

NOCTURNAL MAMMALS

A targeted survey using Remote Cameras was completed across 6 locations of potential habitat for Squirrel Gliders, Koala, Brush-tailed Phascogales and Eastern Pygmy Possum (Figure 6-17) over the period November 2020 – January 2021. Prior to undertaking the survey, ELA consulted with recognised Eastern Pygmy Possum expert Dr. Martin Schultz to determine the optimal habitat to target survey efforts. The methodology was also discussed with Dr. David Geering (Biodiversity Conservation Division, DPIE) who also assisted in the field.

Areas containing hollow bearing trees and shrubby understory were selected and each camera was installed for a minimum of 14 days. Each site contained fifteen (15) Remote Infrared Cameras (1,246 trap nights) which were installed on trees and spaced 50-100 m apart to saturate the area (M. Schultz pers comm 2020). Cameras were baited using a mix of honey, oats and peanut butter with a diluted honey mix poured over the bait ball and on the tree. On day 7 all cameras were rebaited and checked. To assist with fauna identification a 30 cm ruler was attached to the tree next to the bait bag. All images were reviewed by ELA ecologists with further clarification gained from ELA mammal expert Dr. Rodney Armistead.

MICROBATS

The bat fauna assessment was designed to obtain baseline data on bat fauna species that were utilising the Project Site and surrounds, and to target bat fauna species listed in the Schedules of NSW BC Act and Commonwealth EPBC Act. The surveys followed the NSW guidelines which require a minimum of four nights of detection at each location. Anabat Swifts were deployed between 21 December 2020 and 15 February 2021 across 45 sites focusing on proposed turbine locations and near waterways (dams, creeks, Lake Burrendong) (Figure 6-17) with calls being recorded from dusk to dawn. There were no caves, cliffs or crevices within the Project Site that could be used as breeding habitat for cave dwelling microbats. The survey consisted of 210 survey nights and recordings were filtered and analysed by ELA Ecologists.

In addition, two Anabat Swifts were deployed between 15 October 2021 through to 20 November 2021 attached to a wind mast and installed at heights of 5 m and 50 m above the ground. Calls were recorded from dusk to dawn. The survey consisted of 32 survey nights and recordings were filtered and analysed by Specialised Zoological.

The Ultrasonic Anabat Swift detectors deployed at ground level recorded a total of 65,958 call sequences of which 50,483 (76.5%) were assigned to a species. Calls were only positively identified when the defining characteristics were present and there was no chance of confusion between species with overlapping and/or similar calls. The remaining 15,475 call sequences were either too short or were of low quality thus preventing positive identification of bat species. Twenty (20) species of bats were identified from the Anabat recordings, including five (5) threatened species:

- *Chalinolobus dwyeri* (Large-eared Pied Bat)
- *Miniopterus orianae oceanensis* (Large Bent-wing bat)
- *Vespadelus troughtoni* (Eastern Cave Bat)
- *Saccolaimus flaviventris* (Yellow-bellied Sheath-tailed Bat)
- *Chalinolobus picatus* (Little Pied Bat).

Analysis of recordings undertaken by Specialized Zoology found six (6) species of bats recorded at height. *Miniopterus orianae oceanensis* (Large Bent-wing bat) was the only threatened species flying at height. No additional species were recorded.

Another threatened species, *Nyctophilus corbeni* (Corben's Long-eared Bat), listed as vulnerable under both the BC Act and EPBC Act could also be present within the Project Site. This is based upon the recording of calls that could potentially be attributed to this species, as well as the presence of suitable habitat for these species. In this part of NSW, the calls of Corben's Long-eared Bat overlap with those of other more common *Nyctophilus* species which also occur in the area.

The most active or commonly recorded species within the Project Site include the *Vespadelus* species and *Miniopterus* species complex. However, there were low detection rates for calls that could be assigned to threatened species. Twenty-one (21) calls were attributed to the Little Pied Bat occurring at six locations, while twenty-two (22) definite and potential calls attributed to Large-eared Pied Bat were recorded from nine sites.

The Large-eared Pied Bat, Large Bent-wing Bat and Eastern Cave Bat require caves for roosting and can travel up to 60 km each night to forage. Populations are known from Wellington Caves (15 km) and Borenore Caves (50 km) however no species-credits are required for these species given that there are no suitable habitat features (caves, scarps, cliffs, rock, overhangs, and disused mines) within the Project Site.

ASSUMED PRESENCE

Surveys across the Transmission Line – Northern option were not conducted during the required survey timing for many species. This option was initially rejected due to the presence of CEEC, however this option is now being reconsidered. Some species have also been recently included due to updates made to the BAMC, i.e., Key's Matchstick Grasshopper. The following fauna species are assumed present within the northern option until additional surveys can be undertaken.

- *Burhinus grallarius* (Bush Stone-curlew)
- *Cercartus nanus* (Eastern Pygmy Possum)
- *Crinia sloanei* (Sloane's Froglet)
- *Hoplocephalus bitorquatus* (Pale-headed Snake)
- *Keyacris scurra* (Key's Matchstick Grasshopper)
- *Ninox connivens* (Barking Owl)

- *Ninox strenua* (Powerful Owl)
- *Petaurus norfolcensis* (Squirrel Glider)
- *Phascogale tapoatafa* (Brush-tailed Phascogale)
- *Phascolarctos cinereus* (Koala)
- *Tyto novaehollandiae* (Masked Owl).

One night of nocturnal spotlighting and call playback was undertaken along the Transmission Line – Southern option on the west side of Lake Burrendong. Access issues prevented further surveys. This survey effort was not inadequate and therefore the following species have also been included in the assessment:

- *Cercartetus nanus* (Eastern Pygmy Possum)
- *Keyacris scurra* (Key's Matchstick Grasshopper)
- *Ninox connivens* (Barking Owl)
- *Ninox strenua* (Powerful Owl)
- *Petaurus norfolcensis* (Squirrel Glider)
- *Phascogale tapoatafa* (Brush-tailed Phascogale)
- *Tyto novaehollandiae* (Masked Owl)

Due to changes made to the Development Footprint within the Road Upgrade areas, surveys were not undertaken for *Phascogale tapoatafa* (Brush-tailed Phascogale) during the required survey period and therefore credits have also been calculated for these species.

Credits have been calculated but these will be refined once the detailed footprint has been determined. Further targeted surveys may be undertaken to reduce the credit obligation.

6.5.1.6. Species Credit Species

Following the completion of targeted surveys, the species credit species that are present in the Development Footprint are outlined in Table 6-31. In addition to these species credit species, Table 6-32 have been included in the assessment for if the Transmission Line – Northern Option is the preferred option. If the Southern Option is the preferred transmission line option, then the species credit species in Table 6-33 are included in the assessment.

In addition to Table 6-31, the species in Table 6-34 have been included in the assessment for the Road Upgrade areas.

All other candidate species listed in Table 6-31 were considered absent and not subject to further assessment.

Table 6-31: Species credit species across Project Site

Species	Common Name	Species presence	Number of individuals / Habitat (ha)	Biodiversity Risk Weighting
			Flora	
Swainsona recta	Small Purple-pea	Presence assumed as targeted surveys were not undertaken	Associated with PCT 76, 266, 270, 277 and 312 usually in association with *Themeda australis* and *Austrostipa* spp. Vegetation zones 266_low was excluded. • Windfarm – 10.6 ha • Transmission Northern Option – 23.47 ha • Transmission Southern Option – 32.62 • Yarrabin Road Upgrade – 19.65	2
Swainsona sericea	Silky Swainson-pea	Presence assumed as targeted surveys were not undertaken	Found in Box Gum woodlands. Associated with PCT 76, 266, 277, 281, 312, 331 and 461. Areas of Box Gum Woodland except 266_low was included. • Windfarm –25.81 ha • Transmission Northern Option – 24.3 ha • Transmission Southern Option – 33.2 ha • Yarrabin Road Upgrade – 23.74 ha	2
Diuris tricolor	Pine Donkey Orchid	Presence assumed as targeted surveys were not undertaken	Associated with PCT 76, 331 and 461 with grassy understory within the Inland Slopes sub-region. PCT 331_Good was excluded due to the lack of grass cover. • Windfarm –1.31 ha • Transmission Northern Option – 3.62 ha • Transmission Southern Option – 0.21 ha • Yarrabin Road Upgrade – 1.85 ha	1.5
			Fauna	
Aprasia parapulchella	Pink-tailed Legless Lizard	Presence assumed as targeted surveys were not undertaken	Associated with 266, 270, 272, 274, 277, 281, 312, 331 and 461 with a predominantly grassy ground layers with or within 50 m of partially buried rocks. All PCTs listed above in the condition class DNG were included in the BAMC. • Windfarm – 124 ha • Transmission Northern Option- 43.2 ha • Transmission Southern Option- 46.96 ha • Yarrabin Road Upgrade – 29.53 ha	2
Phascolarctos cinereus	Koala	Probable. Recent records and suitable	Areas identified as important habitat for breeding are PCTs associated with feed trees.	2

Species	Common Name	Species presence	Number of individuals / Habitat (ha)	Biodiversity Risk Weighting
		habitat are present on the site. A faint call was potentially heard during call playback so the species cannot be confirmed absent.	All 12 PCTs are associated with koala feed trees (PCT 76, 84, 266, 270, 272, 274, 277, 281, 287, 312, 331, 461). All the PCTs in good condition were put in the BAMC. • Windfarm – 342.15 ha • Transmission Northern Option – 27.96 ha • Transmission Southern Option – 30.48 ha • Yarrabin Road Upgrade – 13.63 ha	

Table 6-32: Species credit species to be included if Northern Transmission Line is preferred

Species	Common Name	Species presence	Number of individuals / Habitat (ha)	Biodiversity Risk Weighting
			Flora	
Austrostipa wakoolia	Spear-grass	Presence assumed as targeted surveys were not undertaken	This species is associated with PCT 76 within open woodlands on alluvial soils in association with *Eucalyptus microcarpa*. • Total area – 2.8 ha	2
Euphrasia arguta		Presence assumed as targeted surveys were not undertaken	This species is associated with PCT 84, 266, and 272 within open forests and mixed grasslands. • Total area – 68.7 ha	3
Tylophora linearis		Presence assumed as targeted surveys were not undertaken	This species is associated with PCT 272, and 461 growing in open forests and dry woodlands. • Total area – 45.1 ha	2
			Fauna	
Burhinus grallarius	Bush Stone-curlew	Presence assumed as targeted surveys were not undertaken	This species is associated with PCT 76, 266, and 461 within open forests and woodlands with a sparse grassy groundlayer and fallen timer. PCT 266 was excluded due to the lack of fallen timber. • Total area – 5 ha	2
Cercartetus nanus	Eastern Pygmy Possum	Presence assumed as targeted surveys were not undertaken	This species is associated with PCT 272 and PCT 461 with a rich shrubby understory. Although they are known to occur in grassy woodlands • Total area – 45.1 ha	2
Crinia sloanei	Sloane's Froglet	Presence assumed as targeted surveys were not undertaken	Sloane's Froglets are associated with PCT 76. • Total area – 2.8 ha	1.5
Hoplocephalus bitorquatus	Pale-headed Snake	Presence assumed as targeted surveys were not undertaken	Associate with PCT 84 with hollows • Total area - 3.7	2

Species	Common Name	Species presence	Number of individuals / Habitat (ha)	Biodiversity Risk Weighting
Keyacris scurra	Key's Matchstick Grasshopper	Presence assumed as targeted surveys were not undertaken	This species was only recently included in the BAMC for PCTs within the IBRA region. It is associated with PCT 266 containing *Themeda triandra* and species of Asteraceae. • Total area – 20.7 ha	2
Ninox connivens	Barking Owl	Presence assumed as targeted surveys were not undertaken	This species is associated with PCT 84, 266, 272 and 461 residing within large hollows. Only PCTs that had trees were included in the assessment. • Total area – 48.72 ha	2
Ninox strenua	Powerful Owl	Presence assumed as targeted surveys were not undertaken	This species is associated with PCT 84. • Total area – 3.7 ha	2
Petaurus norfolcensis	Squirrel Glider	Presence assumed as targeted surveys were not undertaken	This species is associated with PCT 84, 266, 272 and 461 residing within hollows. Only PCTs that had trees were included in the assessment. • Total area – 28 ha	2
Phascogale tapoatafa	Brush-tailed Phascogale	Presence assumed as targeted surveys were not undertaken	This species is associated with PCT 266, 272, and 461. Only the vegetation zones with trees were included. • Total area – 24.3 ha	2
Tyto novaehollandiae	Masked Owl	Presence assumed as targeted surveys were not undertaken	This species is associated with PCT 84, 266, 272 and 461. Only vegetation zones containing trees were included. • Total area – 28 ha	2

Table 6-33: Species credit species to be included if Southern Transmission Line is preferred

Species	Common Name	Species presence	Number of individuals / Habitat (ha)	Biodiversity Risk Weighting
			Fauna	
Burhinus grallarius	Bush Stone-curlew	Presence assumed as targeted surveys were not undertaken west of Lake Burrendong	This species is associated with PCT 266, 287 and 331 where large woody debris (LWD) is present. Only condition classes with LWD were included in the assessment. The habitat within the Inland Slopes area was considered significantly degraded that it was no longer suitable for the species. • Total area SEH – 4.32 ha	2
Cercartetus nanus	Eastern Pygmy Possum	Presence assumed as targeted surveys were not undertaken west of Lake Burrendong	This species is associated with PCT 272 and PCT 461 with a rich shrubby understory. Although they are known to occur in grassy woodlands. • Inland Slopes Total area – 18.7 ha • SEH Total area – 4.9 ha	2

Species	Common Name	Species presence	Number of individuals / Habitat (ha)	Biodiversity Risk Weighting
Keyacris scurra	Key's Matchstick Grasshopper	Presence assumed as targeted surveys were not undertaken	This species was only recently included in the BAMC for PCTs within the IBRA region. It is associated with PCT 266 containing *Themeda triandra* and species of Asteraceae. No suitable habitat within the SEH. • Inland Slopes Total area – 30.1 ha	2
Ninox connivens	Barking Owl	Presence assumed as targeted surveys were not undertaken west of Lake Burrendong	This species is associated with PCT 84, 266, 272, 287 and 331 residing within large hollows. Only VZ that had trees were included in the assessment. • Inland Slopes Total area – 21.28 ha • SEH Total area – 9.2 ha	2
Ninox strenua	Powerful Owl	Presence assumed as targeted surveys were not undertaken west of Lake Burrendong	This species is associated with PCT 84, 287 and 331. Only VZ that had trees were included in the assessment. • Inland Slopes Total area – 0.08 ha • SEH Total area – 2.04 ha	2
Petaurus norfolcensis	Squirrel Glider	Presence assumed as targeted surveys were not undertaken west of Lake Burrendong	This species is associated with PCT 84, 266, 272, 287 and 331 utilising hollows. Only VZ that had trees were included in the assessment. • Inland Slopes Total area – 21.28 ha • SEH Total area – 5.7 ha	2
Phascogale tapoatafa	Brush-tailed Phascogale	Presence assumed as targeted surveys were not undertaken west of Lake Burrendong	This species is associated with PCT 266, 272 and 331. Only VZ with trees were included. • Inland Slopes Total area – 21.2 ha • SEH Total area – 7.2 ha	2
Tyto novaehollandiae	Masked Owl	Presence assumed as targeted surveys were not undertaken west of Lake Burrendong	This species is associated with PCT 84, 266, 272, 287 and 331. Only VZs containing trees were included. • Inland Slopes Total area – 21.28 ha • she Total areas – 4.36 ha	2

Table 6-34: Species credit species included in the assessment along the Yarrabin Road Upgrade

Species	Common Name	Species presence	Number of individuals / Habitat (ha)	Biodiversity Risk Weighting
			Flora	
Austrostipa wakoolia		Presence assumed as targeted surveys were not undertaken	This species is associated with PCT 76 within open woodlands on alluvial soils in association with *Eucalyptus microcarpa*. • Total area – 0.59 ha	2
			Fauna	

Species	Common Name	Species presence	Number of individuals / Habitat (ha)	Biodiversity Risk Weighting
Phascogale tapoatafa	Brush-tailed Phascogale	Presence assumed as targeted surveys were not undertaken	This species is associated with PCT 266, and 272. Only the vegetation zones with trees were included. • Inland Slopes Total area – 14.65 ha	2

6.5.1.7. Ecosystem Credit Species

Ecosystem credit species are listed below. No species were excluded from the assessment based on targeted surveys. However, it is noted that no further assessment of these species was undertaken as any potential impacts would be accounted for through ecosystem credit offsets.

- *Anthochaera phrygia* (Regent Honeyeater)
- *Artamus cyanopterus cyanopterus* (Dusky Woodswallow)
- *Callocephalon fimbriatum* (Gang-gang Cockatoo)
- *Calyptorhynchus lathami* (Glossy Black-Cockatoo)
- *Chalinolobus picatus* (Little Pied Bat)
- *Chthonicola sagittata* (Speckled Warbler)
- *Circus assimilis* (Spotted Harrier)
- *Climacteris picumnus victoriae* (Brown Treecreeper (eastern subspecies))
- *Daphoenositta chrysoptera* (Varied Sittella)
- *Dasyurus maculatus* (Spotted-tailed Quoll)
- *Ephippiorhynchus asiaticus* (Black-necked Stork)
- *Falco subniger* (Black Falcon)
- *Falsistrellus tasmaniensis* (Eastern False Pipistrelle)
- *Glossopsitta porphyrocephala* (Purple-crowned Lorikeet)
- *Glossopsitta pusilla* (Little Lorikeet)
- *Grantiella picta* (Painted Honeyeater)
- *Haliaeetus leucogaster* (White-bellied Sea-Eagle)
- *Hamirostra melanosternon* (Black-breasted Buzzard)
- *Hieraaetus morphnoides* (Little Eagle)
- *Hirundapus caudacutus* (White-throated Needletail)
- *Lathamus discolor* (Swift Parrot)
- *Lophocarpa leadbeateri* (Major Mitchell's Cockatoo)
- *Lophoictinia isura* (Square-tailed Kite)
- *Melanodryas cucullate cucullate* (Hooded Robin (south-eastern form))
- *Melithreptus gularis gularis* (Black-chinned Honeyeater (eastern subspecies))
- *Miniopterus orianae oceanensis (*Large Bent-winged Bat)
- *Neophema pulchella* (Turquoise Parrot)
- *Ninox connivens* (Barking Owl)
- *Ninox strenua* (Powerful Owl)
- *Nyctophilus corbeni* (Corben's Long-eared Bat)
- *Pachycephala inornate* (Gilbert's Whistler)
- *Petroica boodang* (Scarlet Robin)

- *Petroica phoenicea* (Flame Robin)
- *Phascolarctos cinereus* (Koala)
- *Polytelis swainsonii* (Superb Parrot)
- *Pomatostomus temporalis temporalis* (Grey-crowned Babbler (eastern subspecies))
- *Pseudomys novaehollandiae* (New Holland Mouse)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)
- *Saccolaimus flaviventris* (Yellow-bellied Sheathtail-bat)
- *Stagonopleura guttata* (Diamond Firetail)
- *Tyto* novaehollandiae (Masked Owl)
- *Varanus rosenbergi* (Rosenberg's Goanna)

6.5.2. Potential Impacts

The construction and operational phases of the Project have the potential to directly impact biodiversity values associated with clearing of native vegetation and threatened species habitat that cannot be avoided.

The direct impacts of the development on:

- Native vegetation and threatened ecological communities are outlined in Table 6-35
- Threatened species and threatened species habitat are outlined in Table 6-36, Table 6-37, Table 6-38 and Table 6-39
- Prescribed biodiversity impacts are outlined in Section 6.5.2.4.

Direct impacts have been calculated on the current Development Footprint being impacted however, it is likely that upon final design impacts will be less than are shown. The Transmission Line – Southern option has been included in the calculations given that the overall area is larger than the Northern option.

6.5.2.1. Removal of Native Vegetation

Permanent vegetation removal is required for the construction of all infrastructure and some access tracks. Access tracks are required to accommodate the delivery of all infrastructure on large heavy vehicles, including the WTG blades which limits avoidance of all native vegetation and threatened habitat species. These will be maintained over the life of the Project to allow for the maintenance and operation of the Project. Vegetation removal is also required for the installation of the WTGs.

Vegetation removal associated with direct impacts (as outlined in Table 6-35) will be contained to within the Development Corridor (including during both construction and operation). All works associated with the decommissioning of the Project will also be contained within this Development Corridor.

Table 6-35: Direct impacts to native vegetation (Windfarm, Southern Powerline, Yarrabin Road Upgrade)

PCT ID	PCT Name	BC Act	EPBC Act	Wind Farm (ha)	TL* - South (ha)	TL – North (ha)	Road Upgrade (ha)	Total Direct impacts (ha)[5]
76	Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	CE (Part)	CE (Part)	-	-	2.8	0.59	3.37
84	River Oak – Rough-barked Apple – red gum -box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion	Not Listed	Not Listed	0.64	0.08	3.68	2.24	6.65
266	White Box grassy Woodland in the upper slopes sub-region of the NSW South Western Slopes Bioregion	CE (Part)	CE (Part)	32.25	32.6	20.74	2.81	88.4
270	White Box – Tumbledown Reg Gum – Long-leaved Box shrub/grass woodland in fine-grained sediments of the upper Macquarie River Gorge, NSW central western slopes.	CE (Part)	CE (Part)	0.13	-	-	-	0.13
272	White Box – Black Cypress Pine – red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes	Not Listed	Not Listed	300.64	39.71	44.23	19.8	404.4
274	White Box – Rough-barked Apple alluvial woodland of the NSW central western slopes including in the Mudgee Region	CE (Part)	CE (Part)	-	-	-	1.15	1.15
277	Blakely's Red Gum – Yellow Box grassy tall woodland on the NSW South Western Slopes Bioregion	CE (Part)	CE (Part)	1.26	-	-	16.2	17.5
281	Rough-barked Apple – red gum – Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	CE (Part)	CE (Part)	-	0.55	-	2.84	3.4
287	Long-leaved Box – red box – Red Stringybark mixed open forest on hills and hillslopes in the NSW South Western Slopes Bioregion	Not Listed	Not Listed	217.2	5.41	-	-	222.6
312	Yellow Box Grassy tall woodland on valley flats in the upper slopes of NSW South Western Slopes Bioregion and SEH Bioregion	CE (Part)	CE (Part)	0.5	-	-	-	0.5

[5] TRANSMISSION LINE #MAXIMUM DIRECT IMPACTS DEPENDING UPON WHICH TRANSMISSION LINE OPTION IS CHOSEN

PCT ID	PCT Name	BC Act	EPBC Act	Wind Farm (ha)	TL* - South (ha)	TL – North (ha)	Road Upgrade (ha)	Total Direct impacts (ha)[5]
331	Red Stringybark woodland on hillslopes, northern NSW South Western Slopes Bioregion	Not Listed	Not Listed	49.7	2.56	-	-	52.30
461	Tumbledown Gum Woodlands on hills in northern NSW South Western Slopes Bioregion and southern Brigalow Belt South Bioregion	Not Listed	Not Listed	-	-	0.82	1.26	2.08
Cleared / Exotic/ Water				17.8	5.9	1.77	27.0	52.5
TOTAL				**620.2**	**86.6**	**74**	**74**	**855**

6.5.2.2. Removal of Threatened Species Habitat

Direct impacts to threatened species and their habitats are outlined in Table 6-36 (Windfarm), Table 6-37 (Road Upgrades), Table 6-38 (Northern Transmission option) and Table 6-39 (Southern Transmission option) below.

There are also numerous hollow bearing trees (HBTs) within the Project Site. These are located within all vegetation zones and PCTs including the scattered trees within DNG. A 50 m buffer was placed around all WTG and all HBTs present within this buffer were assessed. Surveys undertaken in February 2023 recorded tree species, diameter of breast height (DBH), number of hollows and their size, evidence of occupation and notes recorded on whether the hollows would be suitable for owls, parrots or cockatoos based on the BioNet Threatened Biodiversity Data Collection (TBDC) (DPE, 2023). Most WTGs have been located along cleared ridges. A few WTG locations (WTG 41, WTG 5 WTG 11 and WTG 13) have in excess of 7 HBT's within the buffer zone. Most of the hollows are small, less than 10 cm in diameter.

Table 6-36: Direct impacts to threatened species habitat (Windfarm)

Species	Common Name	BC Act	EPBC Act	Directly impacted number of individuals / habitat (ha)
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V	123.5
Phascolarctos cinereus	Koala	E	E	342.1
Swainsona sericea	Silky Swainson-pea	E	E	25.8
Swainsona recta	Small purple-pea	E	E	10.6
Diuris tricolor	Pine Donkey Orchid	V	-	1.3
KEY: V = VULNERABLE, E = ENDANGERED				

Table 6-37: Direct impacts to threatened species habitat (Road Upgrades – Yarrabin Rd, 12 Mile Rd, Burrendong Dam Rd)

Species	Common Name	BC Act	EPBC Act	Directly impacted number of individuals / habitat (ha)
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V	29.53
Phascolarctos cinereus	Koala	E	E	13.63
Swainsona sericea	Silky Swainson-pea	E	E	23.74
Swainsona recta	Small purple-pea	E	E	19.64
Diuris tricolor	Pine Donkey Orchid	V	NL	1.89
Austrostipa wakoolica	Spear-grass	E	E	0.59
Phascogale tapoatafa	Brush-tailed Phascogale	V	NL	14.65
KEY: V = VULNERABLE, E = ENDANGERED				

Table 6-38: Direct impacts to threatened species habitat (Northern Transmission Line option)

Species	Common Name	BC Act	EPBC Act	Directly impacted number of individuals / habitat (ha)
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V	42.32
Phascolarctos cinereus	Koala	E	E	27.96
Swainsona sericea	Silky Swainson-pea	E	E	24.3

Species	Common Name	BC Act	EPBC Act	Directly impacted number of individuals / habitat (ha)
Swainsona recta	Small purple-pea	E	E	23.47
Diuris tricolor	Pine Donkey Orchid	V	NL	3.62
Austrostipa wakoolica	Spear-grass	E	E	2.8
Phascogale tapoatafa	Brush-tailed Phascogale	V	NL	24.3
Burhinus grallarius	Bush Stone-curlew	E	NL	5.0
Cercartetus nanus	Eastern Pygmy Possum	V	NL	45.1
Crinia sloanei	Sloane's Froglet	V	E	2.8
Euphrasia arguta		CE	CE	68.7
Hoplocephalus bitorquatus	Pale-headed Snake	V	NL	3.7
Keyacris scurra	Key's Matchstick Grasshopper	E	NL	20.7
Ninox connivens	Barking Owl	V	NL	48.72
Ninox strenua	Powerful Owl	V	NL	3.7
Petaurus norfolcensis	Squirrel Glider	V	NL	28
Tylophora linearis		V	E	45.1
Tyto novaehollandiae	Masked Owl	V	NL	28.02
KEY: V = VULNERABLE, E = ENDANGERED				

Table 6-39: Direct impacts to threatened species habitat (Southern Transmission Line option)

Species	Common Name	BC Act	EPBC Act	Directly impacted number of individuals / habitat (ha)
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V	47.01
Phascolarctos cinereus	Koala	E	E	30.48
Swainsona sericea	Silky Swainson-pea	E	E	33.2
Swainsona recta	Small purple-pea	E	E	32.62
Diuris tricolor	Pine Donkey Orchid	V	NL	0.21
Phascogale tapoatafa	Brush-tailed Phascogale	V	NL	28.4
Burhinus grallarius	Bush Stone-curlew	E	NL	4.32
Cercartetus nanus	Eastern Pygmy Possum	V	NL	23.6
Keyacris scurra	Key's Matchstick Grasshopper	E	NL	30.1
Ninox connivens	Barking Owl	V	NL	30.48
Ninox strenua	Powerful Owl	V	NL	2.08
Petaurus norfolcensis	Squirrel Glider	V	NL	26.98
Tyto novaehollandiae	Masked Owl	V	NL	25.58
KEY: V = VULNERABLE, E = ENDANGERED				

6.5.2.3. Indirect Impacts

Indirect impacts of the Project include soil and water contamination, creation of barriers to fauna movement, and generation of excessive dust, light and noise. The indirect impacts of the development are outlined in Table 6-40 below.

Table 6-40: Potential indirect impacts to biodiversity

Indirect impact	Project phase	Nature	Extent	Frequency	Duration	Timing
Sedimentation and contaminated and/or nutrient rich run-off	Construction	Runoff during construction works	10 m from Project Site boundary	During heavy rainfall or storm events	During rainfall events	Short-term impacts
Noise, dust, or light spill	Construction	Noise and dust created from machinery (no night works proposed therefore no light spill)	Noise and dust likely to carry further than 10 m from Development boundary	Daily, during construction works	Sporadic throughout construction period	Short-term impacts
Inadvertent impacts on adjacent habitat or vegetation	Construction	Damage to native vegetation with machinery (demarcation no-go zones)	Development boundary	Nightly during operation of development	Potential at any point during construction	Potential at any point during construction
Transport of weeds and pathogens from the site to adjacent vegetation	Construction / operation	Spread of weed seed or pathogens	Potential for spread into adjacent habitat	Daily, during construction works	Sporadic throughout construction period	Short-term impacts
Vehicle strike	Construction / operation	Increased traffic movements have potential to increase impacts to fauna species	Adjoining roads.	Potential at any time.	Potential at any point during construction and operation of the development	Potential at any point during construction and operation of the development
Trampling of threatened flora species	Construction / operation	Increased traffic movements have potential to increase impacts to fauna species	Adjoining roads.	Potential at any time.	Potential at any point during construction and operation of the development	Potential at any point during construction and operation of the development

Indirect impact	Project phase	Nature	Extent	Frequency	Duration	Timing
Rubbish dumping	Construction / operation	Illegal dumping by construction crews	Potential for rubbish to spread via wind into adjacent vegetation	Potential to occur at any time throughout construction or operational phases	During working hours for construction Potential at any point during operation of the development	During working hours for construction Potential at any point during operation of the development
Increase in predatory species populations	Construction / operation	Potential for an increase in predatory species in the locality through disturbance to vegetation	Throughout adjacent vegetation	Likely to occur gradually after disturbance to habitat and vegetation takes place	For a period after clearing works take place	At any point once clearing and disturbance to habitat take place
Increase in pest animal populations	Construction / operation	Potential for an increase in pest animal populations in the locality through disturbance to vegetation	Throughout adjacent vegetation	Likely to occur gradually after disturbance to habitat and vegetation takes place	For a period after clearing works take place	At any point once clearing and disturbance to habitat take place
Increased risk of fire	Construction / operation	Potential for fire to spark during construction works especially any electrical or machinery works	Throughout adjacent vegetation	Potential to occur at any time throughout construction or operational phases	During working hours for construction Potential at any point during operation of the development	During working hours for construction Potential at any point during operation of the development

6.5.2.4. Prescribed Impacts (Wind Farm Development)

To assess the likely prescribed impacts related to wind farm developments, specifically WTG strike, a series of detailed assessments were undertaken. These assessments included:

- Bat activity monitoring
- Bird utilisation monitoring
- Baseline collision risk assessment
- Collision strike modelling for at risk species

AT RISK BAT SPECIES

Surveys were undertaken across the Project Site to monitor for bat activity using Ultrasonic Bat Detectors (Songmeters). Two methods were employed to detect microbat movements across the Project Site. These events included:

- Bat Activity Monitoring Surveys (BAS) from December 2020 through to February 2021 with a typical bat monitoring method consisting of 45 sites for a total of 210 survey nights; and
- Vertical bat monitoring occurring at 50 m and at 5 m from October 2021 to November 2021.

Hull and Cawthen (2013) found that bats that are adapted to fly in open space or known to forage above the canopy have been found to be at greater risk of WTG strike. This is due to their mode of foraging placing them at greater risk of encountering WTGs and because the wing shape of these bats means they are adapted for fast flight, with low manoeuvrability, lowering the chances that they will avoid blade strike if foraging in proximity to WTGs. This includes species such as South-eastern Free-tailed Bat, Eastern Free-tailed Bat, Yellow-bellied Sheath-tailed Bat, Gould's Wattled Bat and White-striped Free-tailed Bat.

Yellow-bellied Sheath-tailed Bat, Eastern False Pipistrelle and Greater Broad-nosed Bat are ecosystem credit species under BAM and therefore impacts to these species are considered through impacts to native vegetation with which they are associated. However, in terms of impacts from WTG strike at wind farms (a prescribed impact), Yellow-bellied Sheath-tailed Bat is regarded as the species of more specific concern due to this species using open-air species for foraging and flight ecology.

Based on the data collected during the above monitoring programs, the following bat species have moderate (or higher) likelihood of WTG strike:

- *Pteropus poliocephalus* (Grey-headed Flying Fox)
- *Austronomus Australia* (White-striped Freetail Bat)

AT RISK BIRD SPECIES

Bird utilisation surveys were conducted by ELA across the Project Site between December 2020 through to February 2021. Additional sites were surveyed in September 2021. A large proportion of the birds recorded during surveys were observed flying at less than 20 m above the ground, with birds recorded at ground level or within a valley below being the second most recorded. Only 3.3% of all individuals were recorded above 40 m (i.e., within the Rotor Swept Area (RSA)) and was limited to the following species: Australian Magpie, Australian Raven, White-bellied Sea Eagle, Little Eagle, and Wedge-tailed Eagle.

Three species of bird were recorded at heights of 60 – 80 m and 80 m and above, being Australian Raven, White-throated Needletail and Wedge-tailed Eagle. The number of individuals recorded at heights of 40-60 m was 11, with only 6 recorded between 60 – 80 m and then 22 recorded above 80 m in height.

Based on data collected during bird utilising surveys, a review of strike data at surrounding wind farms, aerial habitat mapping and regional migratory pathways, it was concluded that the following bird species have a moderate (or higher) likelihood of WTG strike:

- *Aquila audax* (Wedge-tailed Eagle)
- *Falco cenchroides cenchroides* (Nankeen Kestrel)
- *Hirundapus caudacutus* (White-throated Needletail)
- *Polytelis swainsonii* (Superb Parrot)

COLLISION RISK MODELLING

A Collision Risk Assessment for each of the at-risk species identified above was undertaken using the Refined Band Model (Band, 2000 and Band, 2007) as presented in Christie & Urquhart (2015). This model estimates the collision risk based on the blade rotation and bird and bat speed/size, based on a range of up-wind and down-wind trajectories. The Collision Risk Assessment uses parameter inputs for the WTG specifications, as well as each bird/bat species dimension and behaviour. For each species, the strike risk was modelled at wind speeds of 0, 5, and 10 m/s, to incorporate variability in wind speeds likely to be experienced within the Project Site. Model parameters for each species, as well as the band collision risk for each species is summarised in Table 6-41. Due to their large size, Wedge-tailed Eagles were estimated to have the highest risk of collision compared to other at-risk raptors. Microbat species are considered to have a lower risk of collision than larger bird species due to their size.

Table 6-41: Model parameters and band collision risk for each 'at risk' bird and bat species

Species	Length (m)	Wingspan (m)	Speed Relative to Air (m/s)	Flapping (0) or Gliding (1)	Band Collision Risk
Nankeen Kestrel	0.3	0.7	15	1	5.10%
Superb Parrot	0.4	0.7	15	0	5.37%
White-throated Needletail	0.2	0.6	15	1	4.63%
Grey-headed Flying Fox	0.3	1.0	15	0	5.93%
Wedgetail Eagle	1.06	2.32	15	1	10.97%
White-striped Freetail Bat	0.092	0.395	15	0	3.87%

For 'at risk' species, collision frequency was estimated by multiplying the band collision risk for each species and the estimated bird activity per year (Figure 6-20).

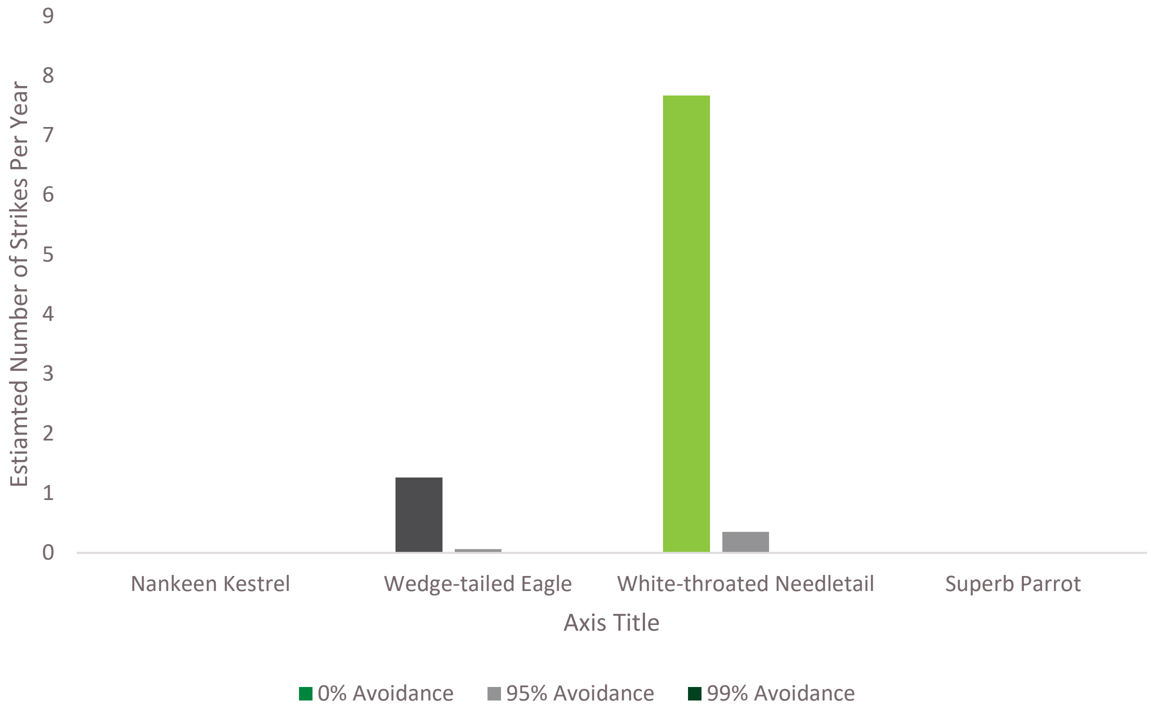


Figure 6-20: Strike risk data for 'at risk' bird species

Collision frequency modelling was not undertaken for the above at-risk bat species due to the inability to derive a clear estimated number of individuals, as the number of calls is not a strong indicator of number of individuals within a sampling event (i.e., because one individual may call numerous times or pass the detector several times).

6.5.2.5. Serious and Irreversible Impacts

The Project has one candidate TEC for Serious and Irreversible Impacts (SAII) values, White Box - Yellow Box - Blakely's Red Gum Grassy Woodland. Table 6-42 summarises this SAII. Location of SAII entities is shown in Figure 6-12.

Table 6-42: SAII Summary

Species / Community	Principle	Direct impact	Species / Community
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland associated with: • **PCT 266** • **PCT 270** • **PCT 274** • **PCT 277** • **PCT 281** • **PCT 312**	Principle 1 and 2	There is 111 ha of TEC within the Development Footprint. Only 1 transmission line option will be chosen which will reduce impacts to the TEC • 90.3 ha if Southern transmission option is chosen or • 77.8 ha if Northern transmission option is chosen.	No listed threshold

An evaluation of the potential impact on White Box - Yellow Box - Blakely's Red Gum Grassy Woodland in accordance with Section 9.1.1 of the BAM was undertaken within the BDAR (Appendix H).

6.5.2.6. Matters of National Environmental Significance

Whilst assessments concluded that no significant impacts are likely to occur, the Project was referred to the Department of Agriculture, Water and Environment (DAWE) and was considered a Controlled Action on 2 June 2021 (2021/8916).

One TEC is present within the Project Site, being White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – Critically Endangered. Two threatened species listed as MNES were recorded, being *Haliaeetus leucogaster* (White-bellied Sea Eagle) and *Hirundapus caudacutus* (White-throated Needletail). A significant impact is unlikely to occur to the TEC present within the Project Site, nor to the two (2) threatened species listed as MNES. Table 6-43 outlines the species that have the potential to occur or were recorded within the Project Site.

Table 6-43: Matters of National Environmental Significance with potential to occur or recorded within the Project Site

MNES	Occurrence
Threatened Ecological Communities	The following TECs were recorded within the Project Site: • White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – Critically Endangered
Threatened Species	The following MNES species were considered to have potential to occur within the Project Site: • *Swainsona recta* (Small Purple-pea) • *Grantiella picta* (Painted Honeyeater) • *Anthochaera phrygia* (Regent Honeyeater) – not on mapped important areas • Lathamus discolor (Swift Parrot) • *Chalinolobus dwyeri* (Large-eared Pied Bat) • *Nyctophilus corbeni* (Corben's Long-eared Bat) • *Phascolarctos cinereus* (Koala) • Polytelis swainsonii (Superb Parrot) • *Pteropus poliocephalus* (Grey-headed Flying-fox) The following MNES species were recorded within the Project Site: • *Haliaeetus leucogaster* (White-bellied Sea Eagle) • *Hirundapus caudacutus* (White-throated Needletail)
Migratory Species	The following migratory species were considered to have potential to occur within the Project Site: • *Myiagra cyanoleuca* (Satin flycatcher) The following migratory species were recorded within the Project Site: • *Hirundapus caudacutus* (White-throated Needletail) • *Apus pacificus* (Fork-tailed Swift)
Wetlands of National Importance	No Wetlands of National Importance are present within or in proximity to the Project Site.

6.5.3. Mitigation Measures

It is noted that this EIS contains a conservative calculation of the biodiversity offset credits required to address the impacts associated with the Development Footprint. Noting that the Project is subject to micro-siting, detailed design, and potentially staging, the biodiversity offset credits are provided as indicative only, and are not presented as a proposed credit requirement.

As outlined in this EIS, the proposed Biodiversity Offset Strategy (BOS) for the Project is to acquire and retire all ecosystem and species credits. The EIS outlines the Project's approach to achieve the required biodiversity offsets using the calculated biodiversity offsets according to the relevant legislation. The biodiversity offset credit liability will be recalculated using the BAMC during the period post-Development Consent based on the impacts of the final Development Footprint, once the detailed design is available.

Once a detailed design has been confirmed, an amendment will be added to this BDAR, and actual offset credits required will be calculated. The retirement of these credits will be carried out in accordance with the NSW Biodiversity Offset Scheme (BOS).

Table 6-44: Mitigation Measures for Biodiversity Impacts

Environmental Impact	Mitigation Measure	Reference Code
General	Prepare a BMP in consultation with the Biodiversity Conservation Division (BCD) within DPE and include a description of the measures that would be implemented for: • minimising the amount of native vegetation clearing within the approved development footprint • minimising the loss of key fauna habitat, including tree hollows • minimising the impacts on fauna on site, including undertaking pre-clearance surveys • minimising the potential indirect impacts on threatened flora and fauna species, migratory species and 'at risk' species • rehabilitating and revegetating temporary disturbance areas • protecting native vegetation and key fauna habitat outside the approved disturbance area • maximising the salvage of resources within the approved disturbance area – including vegetative and soil resources – for beneficial reuse (such as fauna habitat enhancement) during the rehabilitation and revegetation of the site • collecting and propagating seed (where relevant) • controlling weeds and feral pests • controlling erosion • bushfire management • a detailed program to monitor and report on the effectiveness of these measures. The Proponent must implement the approved BMP during construction and operational phases of the Project.	BV001
Native Vegetation	Develop clearing protocols that identify vegetation to be retained, prevent inadvertent damage, and reduce soil disturbance. For example, removal of native vegetation by chain-saw, rather than heavy machinery, is preferable in situations where partial clearing is proposed. Implement clearing protocols including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecological or licensed wildlife handler during clearing events.	BV002
	All staff working on the Project must undertake a biodiversity induction as part of their site familiarisation. This induction will include items such as: • Site biodiversity procedures (vegetation management, exclusion zones and fencing, weed management, unexpected finds protocols for threatened species) • What to do in case of environmental emergency (injured fauna) • Key contacts in case of emergency.	BV003

Environmental Impact	Mitigation Measure	Reference Code
Native Fauna	Prior to the commissioning of any WTGs, the Proponent must prepare a BBAMP in consultation with the BCD within DPE, and to the satisfaction of the Secretary. This plan must include: • A detailed description of the measures that would be implemented on-site for minimising bird and bat strike during operation of the development. • Trigger levels for further investigation of the potential impacts of the Project on bird or bat species or populations. • An adaptive management program that would be implemented if the development is having an adverse impact on a particular threatened or 'at risk' bird and/or bat species or populations. • A detailed program to report and monitor the effectiveness of these measures and any bird/bat strikes on site. Provisions for a copy of all raw data collected as part of the monitoring program to be submitted to the BCD within DPE and the Secretary.	BV004
	Utilise soft-felling techniques for all habitat trees with the construction area. A qualified ecologist/licenced wildlife handler should supervise habitat tree removal in accordance with best practise methods. All removal of hollow bearing trees must be supervised by an experienced ecologist to reduce the risk of significant injury or fatality to fauna.	BV005
	Undertake pre-clearance surveys prior to tree clearing associated with the construction area. A qualified ecologist/licenced wildlife handler will supervise tree removal in accordance with best practise methods.	BV006
	Develop a procedure for the relocation of habitat features (e.g., fallen timber, hollow logs) to retained habitat adjacent the Development Footprint. Relocation of timber to retained habitat should be undertaken in consultation with the site ecologist to ensure threatened species and sensitive environments are not harmed during this process. BV007	BV007
	The Project will only undertake construction or decommissioning activities between: • 7 am to 6 pm Monday to Friday • 8 am to 1 pm Saturdays. Notwithstanding, works undertaken outside these hours may occur where the activity is inaudible, for emergency works, delivery of certain materials, in accordance or where agreement from the Secretary has been provided. Certain activities will require work to be conducted outside normal work hours to prevent damage to concrete tower bases and trenches, to reduce the safety risk of open trenches and to reduce the risk of tower self-oscillation. Some examples of these activities include: • Concrete Pours: • In-ground Electrical Works: • WTG Installation.	BV008
	Any active breeding or nesting sites identified during clearance surveys associated with the construction must be avoided in August, September and October which is the breeding/nesting period for most fauna species.	BV009
Biodiversity Offsets	Once a suitable offset strategy has been identified, the Proponent must provide the following to DPE:	BV010

Environmental Impact	Mitigation Measure	Reference Code
	• If land-based offset chosen: o Description of the proposed offset property o The mechanism proposed to secure the offset for biodiversity outcomes o Ecosystem credit summary o Species credits o Management actions to improve biodiversity values. Confirmation of secured required credits through the open credit market, and/or payments to the Biodiversity Conservation Fund	

6.6 Traffic and Transport

A Traffic and Transport Impact Assessment has been undertaken by Stantec (2023, Appendix I) in accordance with the requirements of the SEARs, which include:

- *Assess the construction, operational and decommissioning traffic impacts of the development on the local, regional and State Road network;*
- *Provide details of the peak and average traffic volumes (including light, heavy and over-mass / over-dimensional vehicles) and transport and haulage routes during construction, operation, and decommissioning, including traffic associated with sourcing raw materials (water, sand and gravel);*
- *Assess the potential traffic impacts of the project on road network function including intersection performance, site access arrangements, site access and haulage routes, and road safety, including school bus routes and school zones;*
- *Assess the capacity of the existing road network to accommodate the type and volume of traffic generated by the project (including over-mass / over-dimensional traffic haulage routes from port*

to site) during construction, operation, and decommissioning;

- *Assess of the likely transport impacts to the site access and haulage routes, site access point, any rail safety issues, any Crown Land (including the existing Travelling Stock Route network), particularly in relation to the capacity and conditions of the roads and use of rail level crossings (and rail safety assessment if required), and impacts to rail underbridges and overbridges;*
- *Cumulative impact assessment of traffic from nearby developments; and*
- *Provide details of measures to mitigate and / or manage potential impacts including a schedule of all required road upgrades (including resulting from over mass / over dimensional traffic haulage routes), road maintenance contributions, and any other traffic control measures, developed in consultation with the relevant road and / or rail authority.*

Assessment Overview

Traffic impacts generated by the Project were assessed at each of the construction, operational and decommissioning phases by Stantec.

A route study was prepared by Rex J Andrews Engineering to identify the optimal route to transport WTG components to the Project Site. Transport routes 2A and 2B were selected as the preferred routes.

In addition to the OSOM vehicles, traffic impacts will be generated by:

- Light and heavy vehicles used to deliver construction materials and personnel during the construction phase
- Light vehicles used by onsite personnel and visitors during the operation phase.

During the 24–30-month construction phase, the Project is estimated to generate an average of 153 one-way vehicle trips per day. The modal split between vehicle classes will fluctuate between various construction months, with light vehicles accounting for 81-83% of traffic generated, and heavy vehicles making up 17%. During months 15-21 of the construction phase of the Project, 2% of traffic will be generated by OSOM vehicles.

The operational phase of a project is generally between 25-30 years. Routine maintenance during the operational phase is likely to generate traffic equivalent to 20-30 trips daily, assuming each employee drives themselves to and from the site (on the basis of 10-15 employees).

The decommissioning phase would conceptually generate a similar or lesser number of trips than the construction phase. A significantly reduced workforce and less traffic generation of heavy vehicles can be expected during this phase (i.e. no vehicles required to pour concrete slabs).

Mitigation measures for traffic and transport are proposed, including the upgrade of three intersections located on Route 2A to accommodate the OSOM vehicles. Upgrades to these intersections are discussed in Section 6.6.3.

6.6.1. Existing Environment

The Project Site is located within Central West NSW, approximately 30 km south-east of Wellington and to the east of Lake Burrendong. The Project Site is in Yarrabin, approximately 230 km to the northwest of Sydney and approximately 250 km to the west of Newcastle. The existing road network and transport options in the vicinity of the Project Site are presented below.

6.6.1.1. Road Network

The Project Site is primarily accessed through Burrendong Dam Rd, however due to the size of the Project Site, and the fact it is portioned by the lake, there are other access points, with secondary access points located on Tara Road and Burrel Creek Road (Figure 6-21). The local road network is described in Table 6-45 and presented in Figure 6-22. Roads are presented in order of proximity to the Project Site with Burrendong Dam Road being the closest. All roads identified in the SEARs have been assessed for construction, operational and decommissioning traffic impacts.

All roads in NSW are categorised by Transport for New South Wales (TfNSW) based on their role in the road network and for road management responsibilities, and are categorised as:

- State roads link urban and rural centres for the movement of people and freight across the state.
- Regional roads are secondary roads that provide connectivity between towns / places of interest.
- Local roads are low-capacity roads that provide local access to residences and businesses.

Table 6-45: Local road network description

Road	Description	Classification	Speed Limit (km/h)	Road Width (m)	Sealed / Unsealed
Burrendong Dam Road	Local road only providing local access to rural properties. The road is predominantly unsealed and there is a variable road width. For unsealed roads, the default speed limit is assumed to be 80 km/h. Burrendong Dam Road will be used by all OSOM vehicles, light vehicles and heavy vehicles accessing the site.	Local	80 km/h	Variable	Unsealed
Fashions Mount Road	A local road providing access to a botanic garden, caravan park and local rural properties. The road is sealed and has a width of approximately 5.0 – 6.0 m. For sealed rural roads, the default speed limit is 100 km/h.	Local	100 km/h	5 – 6 m	Sealed
Tara Road	A local road providing access to a sport and recreation centre and local properties. The road is a mixture of sealed and unsealed with a road carriageway width of approximately 5.0 – 6.0 m. For sealed rural roads, the default speed limit is 100 km/h, for unsealed roads the default speed limit is assumed to be 80 km/h. Tara road may be used by light and heavy vehicles associated with works on the western side of Burrendong Lake, originating in Wellington.	Local	100 km/h - 80 km/h	5 – 6 m	Sealed/ Unsealed
Burrel Creek Road	A local road only providing local access to rural properties. The road is predominantly unsealed and has a road carriageway width of approximately 4.0 m - 5.0 m (therefore can only safely carry traffic in one direction). For unsealed roads, the default speed limit is assumed to be 80 km/h. Burrel Creek Road is signposted as a No Through Road. Burrel Creek Road may be used by light and heavy vehicles associated with works on the western side of Burrendong Lake, originating from Wellington.	Local	80 km/h	4 – 5 m	Unsealed (mostly)
Yarrabin Road	Local road only providing local access to rural properties. The road has a mixture of sealed and unsealed sections and there is a variable road width. For sealed rural roads, the default speed limit is 100 km/h. For unsealed rural roads, the default speed limit is assumed to be 80 km/h. A 20 km section of Yarrabin Road (running north-south) has been identified as part of both OSOM Haulage Routes 2A and 2B. Light and heavy vehicles originating from Wellington and Dubbo will also use this section of Yarrabin Road. A 16.5 km section of Yarrabin Road (running east-west) will be used by light and heavy vehicles originating from Mudgee.	Local	100 / 80 km/h	Variable	Sealed/ Unsealed
Twelve Mile Road	Local road off Goolma Road, only providing local access to rural properties. The road is a mixture of sealed and unsealed road. For unsealed roads, the default	Local	80 km/h	Variable	Unsealed

Road	Description	Classification	Speed Limit (km/h)	Road Width (m)	Sealed / Unsealed
	speed limit is assumed to be 80 km/h. For sealed roads, the default speed limit is assumed to be 100 km/h. A 12.5 km section has been identified as part of both OSOM Haulage Route 2A and 2B. Light and heavy vehicles originating from Wellington and Dubbo will also use Twelve Mile Road.				
Burrendong Way	Classified regional road (MR573) linking the Mitchell Highway at Appley to the Mitchell Highway at Orange. The road has a single lane of travel in each direction and has a posted speed limit of 100 km/h. The road carriage way is approximately 6.0 – 7.5 m in width and there are no shoulders or edge line markings. Either a 7.5 km or 16.5 km section of Burrendong Way will be used by light and heavy vehicles associated with works on the western side of Burrendong Lake, originating in Wellington.	Regional	100 km/h	6 – 7.5 m	Sealed
Saxa Road	Classified regional road (MR353) linking the Golden Highway at Elong Elong to the Mitchell Highway at Wellington, and this road allows haulage vehicles to bypass the town of Dubbo. For roads not in an urban area, the default speed limit is 100 km/h. The carriageway is narrow at approximately 6.0 m in width with no hard shoulder on the road edges. Saxa Road will be used by OSOM vehicles on Haulage Route 2A.	Regional	100 km/h	6.0	Sealed
Hill End Road	Classified regional road (MR216) which connects the Castlereagh Highway to the town of Hill End. The road has a single lane of travel in each direction and has a posted speed limit of 100 km/h. The road carriageway is approximately 6.0 m -7.0 m in width and there are no shoulders or edge line marking. A 9.5 km section will be used by light and heavy vehicles originating from Mudgee.	Regional	100 km/h	6.0 – 7.0	Sealed
Goolma Road	State Road (MR633) between Wellington and Mudgee in western NSW. The road has a single lane of travel in each direction and has a posted speed limit of 100 km/h. The road has varying widths, often between 6.0 m - 7.0 m, and most sections have a small shoulder and edge line marking. A 42 km section of Goolma Road between Mitchell Highway and Twelve Mile Road will be used by OSOM vehicles on Haulage Route 2A, as well as light and heavy vehicles from Wellington and Dubbo. A 21 km section will be used by OSOM vehicles on Haulage Route 2B.	State	100 km/h	6.0 – 7.0	Sealed
Golden Highway	East-west rural highway (HW27) which links Dubbo to the Hunter region, and eventually the Port of Newcastle via New England Highway and Hunter Expressway. It is classified as a State Road with a posted speed limit of 100 km/h.	State	100 km/h	Variable	Sealed

Road	Description	Classification	Speed Limit (km/h)	Road Width (m)	Sealed / Unsealed
	The highway predominantly has one lane of travel in each direction, with segments where overtaking lanes exist. The Golden Highway will be the main highway used to transport OSOM freight from the PoN to within proximity of the Project Site.				
Castlereagh Highway	North-south rural highway (HW18) in western NSW that connects Lithgow to the Queensland border. It is classified as a State Road with a posted speed limit of 100 km/h between Gulgong and Caerleon. The road has one travel lane in each direction and the carriageway is approximately 9.0 m - 9.5 m wide, inclusive of a shoulder on each side. A 42 km section of the highway has been identified as part of OSOM Haulage Route 2B. A 2-4 km section just north of Mudgee will also be used by light and heavy vehicles originating from Mudgee.	State	100 km/h	9.0 – 9.5	Sealed
Mitchell Highway	East-west rural highway (HW7) in western NSW that connects Bathurst to Nyngan. It is classified as a State Road with a posted speed limit of 80 km/h just outside the township of Wellington. The highway will be used by OSOM vehicles as a link between Saxa Road and Goolma Road in Wellington, and between Dubbo and Wellington for any light or heavy vehicles originating from Dubbo.	State	80 km/h	Variable	Sealed

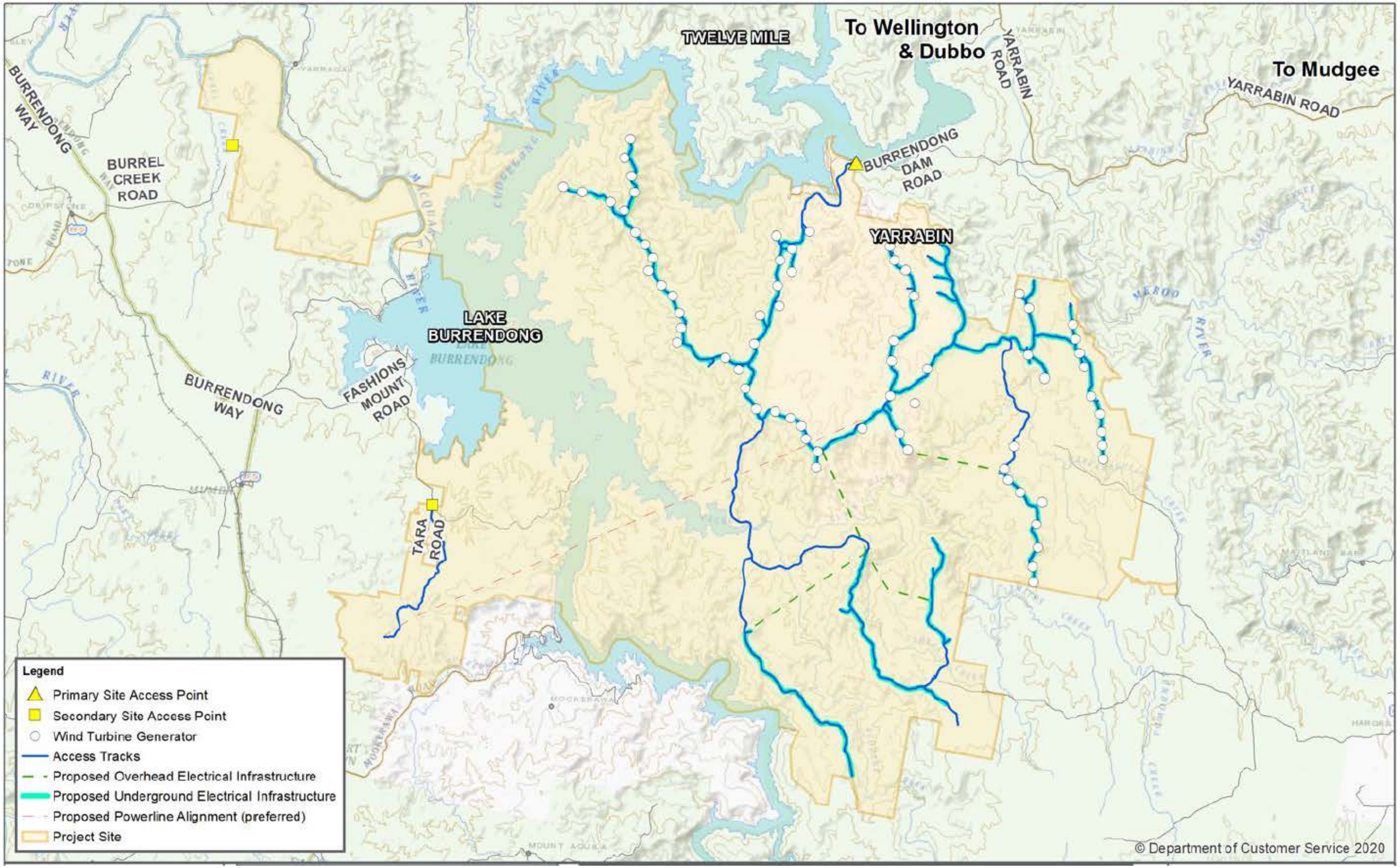


Figure 6-21: Project Site layout including access points and access tracks (Stantec, 2023)

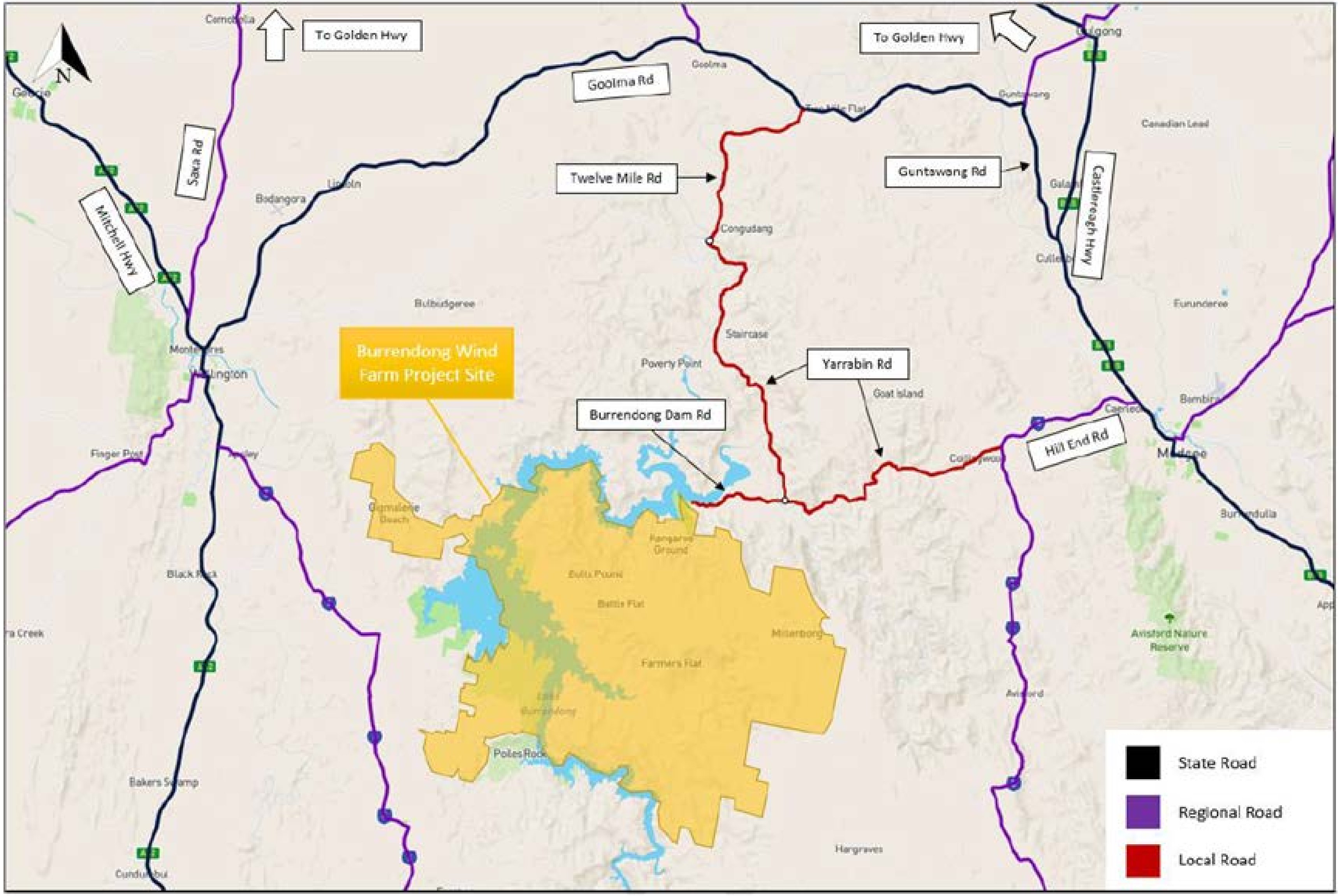


Figure 6-22: Local road network

6.6.1.2. Traffic Volumes

Traffic count data has been obtained from multiple sources including Mid-Western Regional Council, MetroCount data supplied by TfNSW and previously submitted SSDA traffic assessments within close proximity to the Project Site.

Where conflicting traffic volume data was obtained, the most accurate dataset was selected based on source, reliability, and survey year. No traffic volume data was available for Burrendong Way, Fashions Mount Road, Tara Road, and Burrel Creek Road. For these roads it was assumed that they would carry similar traffic volumes to a comparable road. The data sources range from between 2011 to 2022 and as such, all traffic volumes have been factored up by an assumed growth rate of 1% per annum to 2023.

The 2023 average daily traffic volumes, peak hour volumes, heavy vehicle percentages and data sources are all shown in Table 6-46. The median AM Peak Hour time from the data collected was 8.00 am – 9.00 am, and the median PM Peak Hour time was 3.00 pm – 4.00 pm.

Table 6-46: Anticipated 2023 Daily Traffic Volumes and Peak Hour Volumes

Road	Average Daily Traffic Volume (vpd)	Peak Hour Volume (vph)	Traffic Volume Source	2023 Average Daily Traffic Volume (vpd)	Heavy Vehicle Percentage
Burrendong Dam Road	73	11[1]	Mid-Western Regional Council (2022)	74	5%[2]
Fashions Mount Road	*201**	*31**	**Assumed to be similar to Yarrabin Road*	*203**	*5%**
Tara Road	*201**	*31**	**Assumed to be similar to Yarrabin Road*	*203**	*5%**
Burrel Creek Road	*73**	*11**	**Assumed to be similar to Burrendong Dam Road*	*74**	*5%**
Yarrabin Road	201*	31[1]	Mid-Western Regional Council (2022)	203	5%[2]
Twelve Mile Road	90	14[1]	Mid-Western Regional Council (2022)	91	5%[2]
Burrendong Way	*1444**	*200**	**Assumed to be similar to Hill End Road*	*1589**	*10%**
Saxa Road	485	49	Wellington North Solar Farm (GHD, 2018)	510	25%
Hill End Road	1444	200	Crudine Ridge Wind Farm (Samsa, 2013)	1589	10%
Goolma Road	870	120	Uungula Wind Farm (Samsa, 2019)	905	14%
Golden Highway	2050	170	Uungula Wind Farm (Samsa, 2019)	2132	15%
Castlereagh Highway	3289	300	MetroCount Data (TfNSW, 2011)	3684	12%
Mitchell Highway	2520	230	Uungula Wind Farm (Samsa, 2019)	2621	15%

[1] Peak hour volume assumed to be 15% of the daily traffic volume / [2] Assumed values

6.6.1.3. Accident History

The history of accidents on the regional and local roads which may be used by haulage vehicles to access the site are summarised below in Table 6-47. TfNSW provides details of all recorded accidents in NSW within the last 5-year reporting period (2017 – 2021).

Table 6-47: Accident history (2017 - 2021) on regional and local roads

Road	Non-Casualty	Minor Injury	Moderate Injury	Serious Injury	Fatal	Total
Saxa Road	2	2	6	2	0	**12**
Burrendong Way	3	1	2	4	0	**10**
Fashions Mount Road	0	0	0	1	0	**1**
Tara Road	0	0	0	1	0	**1**
Yarrabin Road	0	0	1	0	0	**1**
Hill End Road	1	0	2	1	0	**4**
Twelve Mile Road	0	0	0	0	0	**0**
Burrel Creek Road	0	0	0	0	0	**0**
Burrendong Dam Road	0	0	0	0	0	**0**

Of the twelve (12) recorded crashes on Saxa Road, eight (8) were off-road types of accidents. The four (4) remaining crashes were overtaking, rear end and on-path types of crashes. On Saxa Road, four (4) crashes occurred at the Saxa Road/Muronbung Road intersection, two (2) occurred on a horizontal curve near the Saxa Road/Mine Road intersection, and the remaining crashes occurred at separate locations. The off-road types of accidents occurring at these locations in particular indicate that drivers on Saxa Road may be misjudging the bends in these locations and not slowing down to appropriate speeds to navigate the curves.

There have been no recorded accidents within the latest 5-year reporting period (2017 – 2021) on Twelve Mile Road, Burrel Creek Road or Burrendong Dam Road. There are no apparent trends relating to the crashes on Burrendong Way or Hill End Road.

Figure 6-23: Accident location corner of Saxa Road and Mine Road

6.6.1.4. School Bus Routes

There are no regular public transport services in the vicinity of the Project Site apart from school bus services. Bus companies run charter services in regional areas so that students can travel from their homes to schools in regional centres. Table 6-48 presents School Bus Routes that use roads that are likely to be impacted by the construction of the project. School busses travel various different routes to deliver children to schools in Dubbo, Wellington, Goolma, and Mudgee. All bus routes have a morning and afternoon services. Morning services run between 7:00 am to 9:00 am while afternoon services run from 3:00 pm to just after 5:00 pm.

Table 6-48: School bus routes (Stantec, 2023)

Bus Route	Roads Affected	Origin and Destination	Morning Bus Time	Afternoon Bus Time
S137	Golden Highway	Dunedoo to Dubbo schools	07:25 – 08:49 am	15:30 – 17:05 pm
S109	Saxa Road	Saxa Road to Wellington schools	07:10 – 08:45 am	15:10 – 16:35 pm
S106	Goolma Road	Mt Bodangora to Wellington schools	08:05 – 08:46 am	15:07 – 16:05 pm
WA15 &WP15	Goolma Road	Cullenbone to Goolma schools	07:25 – 09:00 am	15:10 – 16:40 pm
MA10 & MP10	Yarrabin Road and Hill End Road	Yarrabin to Mudgee schools	08:03 – 08:53 am	15:30 – 16:20 pm
MA11 & MP11	Hill End Road	Hargraves to Mudgee schools	07:33 – 08:46 am	15:28 – 16:50 pm
MA15 & MP15	Hill End Road	Windeyer to Mudgee schools	07:25 – 08:50 am	15:30 – 16:48 pm

6.6.1.5. Crown Land Roads

Crown roads were established during the settlement of NSW and are part of the state's public road network. Generally, Crown public roads provide access to freehold and leasehold land where little or no subdivision has occurred since original Crown subdivision of NSW in the early nineteenth century.

As per the advice from Crown Land NSW in the SEARS requirements, crown land that will be impacted by the development will initially require consent to occupy by way of a Crown land licence, but powerlines will require an easement. Consent of the NSW Aboriginal Land Council is required before any licence/acquisition/easement can be considered. For Crown land already under Tenure or with Land Managers, all discussions for works/occupation will need to be with the Land Manager.

Locations of significance along the OSOM route on Yarrabin Road and Burrendong Dam Road are highlighted in Figure 6-24 and Figure 6-25. The images show any existing crown enclosure permits, crown licenses, crown leases and crown reserves.

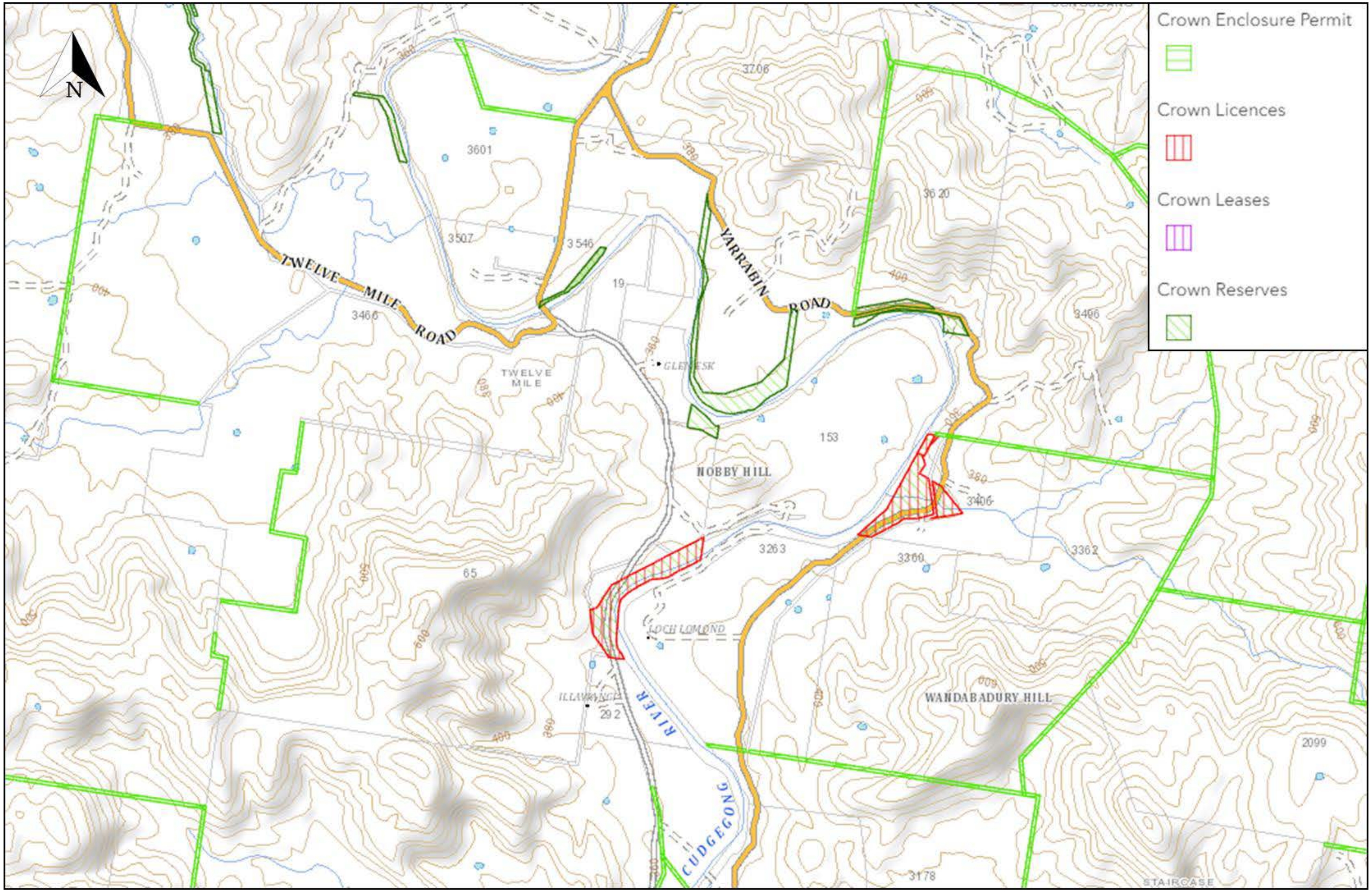


Figure 6-24: Crown Land - Yarrabin Road, just south of Twelve Mile Road (Stantec, 2023)

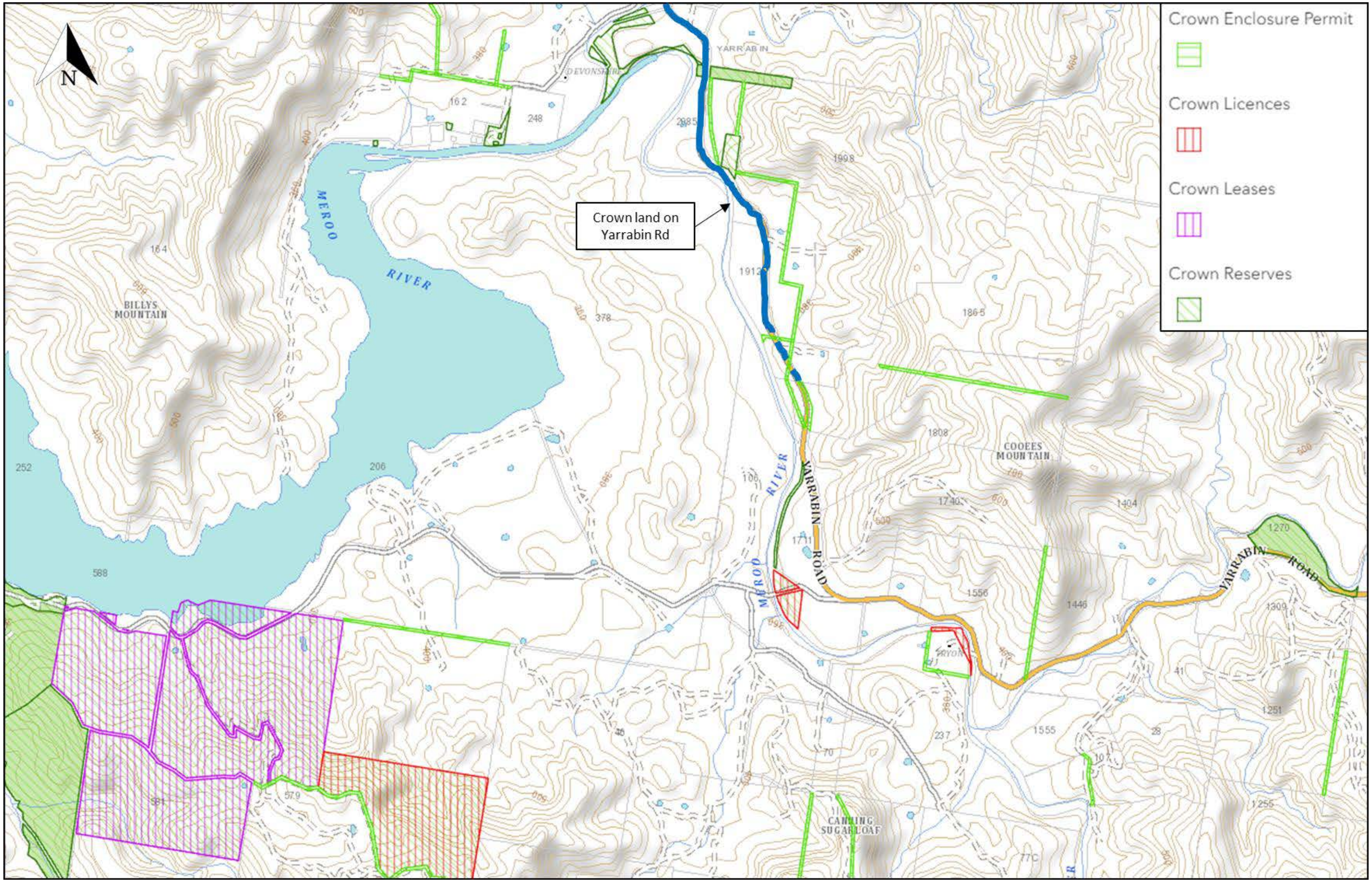


Figure 6-25: Crown Land - Yarrabin Road, just north of Burrendong Dam Road (Stantec, 2023)

6.6.2. Potential Impacts

Potential impacts of the Project are broken down into construction impacts, operational impacts, and decommissioning impacts. Prior to discussion of the impacts the route study will be discussed as the proposed route is vital to understanding the potential impacts.

6.6.2.1. OSOM Route Study

Due to the complexities and logistics required to transport WTG components to the Project Site a route study was undertaken to identify the optimal route. The route study was prepared by Rex J Andrews Engineering (2022) and is provided in Appendix J.

All WTG components will be shipped and stored at the Port of Newcastle until they are ready to be transported to the project site. Two transport Route options were assessed in the study and Option 2A and 2B were selected as the preferred routes (Figure 6-26). Routes 2A and 2B both follow the same path from the Port of Newcastle to the intersection of Golden Highway / Castlereagh Highway, Dunedoo. From this intersection, the OSOM vehicles transporting the WTG components will take a different route (Route 2A) to OSOM vehicles transporting the remaining WTG components (Route 2B). This is due to Route 2B not being able to accommodate the vehicles transporting WTG blades (82 m).

Routes 2A and 2B then recombine at the intersection of Goolma Road / Twelve Mile Road, Two Mile Flat, situated north of the Project Site. Both routes use Twelve Mile Road, Yarrabin Road and Burrendong Dam Road to reach the site from the nearest State Road (Goolma Road – MR633). It is assumed that OSOM vehicles will use the same routes on their return journey that they used to access the Project Site.

In addition to the OSOM vehicles, traffic impacts from the Project will be generated by:

- Light and heavy vehicles used to deliver construction materials and personnel during the 2-year construction phase
- Light vehicles used by onsite personnel and visitors during the 30-year operation phase.

Table 6-49 summarises the main findings of the Route Study and lists potential works required along the OSOM routes. The potential issues noted in the table below will need to be addressed as part of the post-EIS Traffic Management Plan (TMP) and in the detailed design stage. Of particular significance is the road pavement width and quality along Twelve Mile Road, Yarrabin Road and Burrendong Dam Road. Mid-Western Regional Council have suggested that these roads be sealed and widened to 7.2 m (6.2 m for travel lanes and 0.5 m shoulders on each side) to align with rural road width guidelines contained in Austroads Guide to Road Design Part 3 (2021).

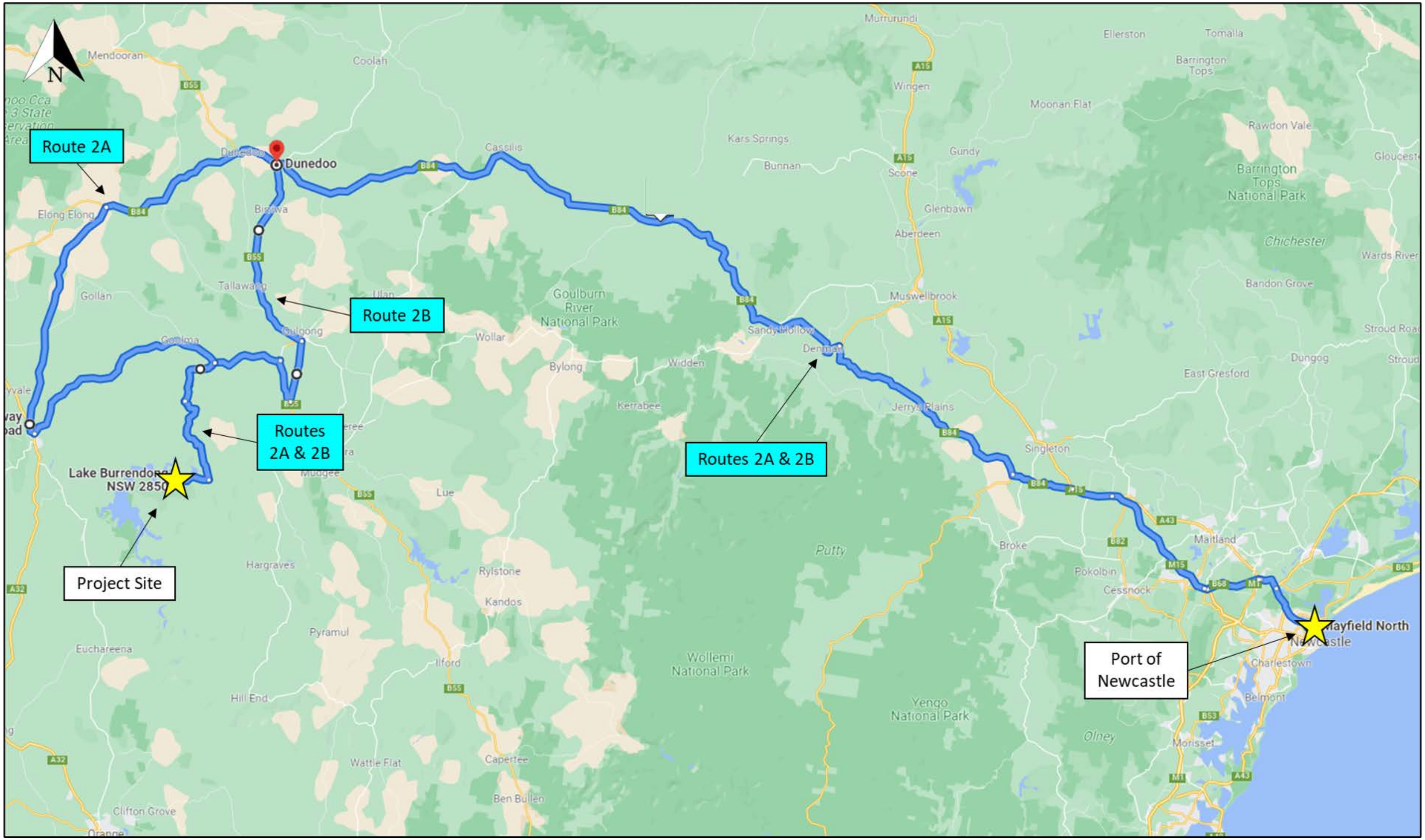


Figure 6-26: Preferred route - 2A and 2B

Table 6-49: Summary of works required on OSOM Routes (Rex J. Andrews, 2022)

Number	Location	Potential Issue/Works Required	Route(s)	Proposed in a previous EIS?
1	Port of Newcastle	Access to local roads from the port will require some upgrades including the installation of hardstand and relocating fences.	Routes 2A & 2B	Yes – Uungula Wind Farm
2	George St / Industrial Drive, Mayfield	Installation of hardstand and relocation of a traffic signal.	Routes 2A & 2B	Yes – Uungula Wind Farm
3	Industrial Drive / Maitland Road	Centre median island to be lowered.	Routes 2A & 2B	Yes – Uungula Wind Farm
4	John Renshaw Drive / Hunter Expressway	Police required to stop eastbound traffic on Hunter Expressway to allow OSOM vehicle to make turn at the roundabout.	Routes 2A & 2B	Yes – Uungula Wind Farm
5	New England Highway / Golden Highway	Moderate amount of works required to allow for the turn.	Routes 2A & 2B	Yes – Uungula Wind Farm
6	Golden Highway	Several corners require modifications to allow for the turning OSOM vehicle. Police required to stop eastbound traffic on Golden Highway to allow OSOM vehicle to travel onto the incorrect side of the road for approximately 400 m.	Routes 2A & 2B	Yes – Uungula Wind Farm
7	Golden Highway / Wargundy Street, Dunedoo	No Parking Zone required.	Route 2A	Yes – Uungula Wind Farm
8	Golden Highway / Saxa Road	Installation of hardstand, relocation of a drainage pipe, relocation of side markers.	Route 2A	Yes – Uungula Wind Farm
9	Saxa Road	Two floodways and two crests – further survey work required to confirm suitability.	Route 2A	Yes – Uungula Wind Farm
10	Saxa Road, Mitchell Highway	Installation of hardstand, removal of some signage.	Route 2A	Yes – Uungula Wind Farm
11	Mitchell Highway / Goolma Rd, Wellington	Installation of hardstand, relocation / removal of several signs, relocation of two light posts.	Route 2A	Yes – Uungula Wind Farm
12	Goolma Rd / Twelve Mile Road	Installation of hardstand, relocation of some signage, removal of a tree.	Routes 2A & 2B	No

Number	Location	Potential Issue/Works Required	Route(s)	Proposed in a previous EIS?
13	Twelve Mile Road	Road pavement needs to be upgraded and widened to 5.5 m, road realignment required in some sections, installation of hardstand, acquisitions of land from property owners, replacement of Piambong Bridge, large amounts of vegetation removal, vertical curve modifications, relocation of a power pole.	Routes 2A & 2B	No
14	Yarrabin Road	Road pavement needs to be upgraded and widened to 5.5 m, road realignment required in some sections, installation of hardstand, acquisitions of land from property owners, large amounts of vegetation removal, vertical curve modifications, floodway modifications.	Routes 2A & 2B	No
15	Burrendong Dam Road	Road pavement needs to be upgraded and widened to 5.5 m -6.5 m, road realignment required in some sections, installation of hardstand, possible acquisitions of land from property owners, large amounts of vegetation removal, vertical curve modifications, modification of Meroo River Bridge.	Routes 2A & 2B	No

6.6.2.2. Construction Impacts

The construction of the project is expected to take 24 months but may take up to a maximum of 30 months. On average, construction is estimated to generate approximately 151 one-way vehicle trips per day during construction months 1-14 and 22-24, and approximately 155 one-way vehicle trips per day during construction months 15-21. Across the entire 24-month construction program the average is 153 one-way vehicle trips per day (16% lower than the maximum traffic generation rate during months 9-10).

Across the construction phase, these traffic generation rates will vary between a minimum of 136 vehicles/day at the start of construction, up to a maximum of 182 vehicles/day during months 9/10. The change in the amount of vehicle trips across the months is associated to the delivery of WTG components that require OSOM vehicles for transportation. The average modal split of traffic generation is shown in Table 6-50 below.

Table 6-50: Average modal split of traffic generation

	Months 1 - 14 & 22 - 24		Months 15 - 21	
	Average One-way Trips	Percentage of Traffic Generation	Average One-way Trips	Percentage of Traffic Generation
Light vehicles	125 veh/day	83%	125 veh/day	81%
Heavy vehicles	26 veh/day	17%	26 veh/day	17%
Over-size over-mass vehicles	0 veh/day	0%	4 veh/day	2%
Total	**151 veh/day**	**100%**	**155 veh/day**	**100%**

LIGHT VEHICLES AND HEAVY VEHICLES

For most of the construction phase, it is anticipated that the average workforce on-site will be approximately 250 employees. During peak construction periods, this may increase up to a maximum of 375 employees. From previous experience in wind farm projects, the average carpooling rate is approximately two (2) employees per light vehicle over six (6) days a week, with a small number of minibuses used as well. On average, this would result in 125 vehicles going to and from the site each day. Light vehicles are estimated to make up approximately 81-83% of the total traffic generated during construction. The modal split between vehicle classes will fluctuate between various construction months.

During construction, employees in light vehicles are assumed to arrive at an 80% / 20% in / out distribution in the AM peak hour, and a 20% / 80% in / out distribution in the PM peak hour. The period with the highest traffic generation will be months nine and ten, with 182 trips entering the site and 132 trips leaving the site in a single day (total of 364 trips). This is presented in Table 6-51.

Heavy vehicle deliveries will also fluctuate over the 24-month construction period. Months 9-10 are expected to generate the heaviest vehicle deliveries for the construction of the wind farm foundations and electrical substations. It is anticipated that there will be between 136 and 182 daily one-way traffic movements during this period, with construction months 9 and 10 generating the highest traffic flow of 125 light vehicles/day and 57 heavy vehicles/day.

Based on location, population and availability of resources, general light vehicle traffic generated by employees and heavy vehicle deliveries are assumed to originate from the following locations:

- Mudgee – 60% (Approximately 40-minute drive via Route 1)
- Wellington – 20% (Approximately 90-minute drive via Route 2)
- Dubbo – 20% (Approximately 110-minute drive via Route 2).

Vehicles travelling to the secondary access point(s) are assumed to originate from Wellington (50%) and Dubbo (50%).

Routes 1 and 2 are shown in Figure 6-27.

Table 6-51: Average modal split of traffic generation

Vehicle Type	Total Trips / Day	Peak Hour Factor	Total Peak hour Movements	AM Peak (in / out)	PM Peak (in / out)
Light Vehicles	250	50% (1)	125	100 / 25	25 / 100
Heavy Vehicles	114	9.1% (2)	11	6 / 5	5 / 6
Total	**364**		**136**	**106 / 30**	**30 / 106**
Notes: (1) Worst case scenario, assuming all one-way trips occur during the peak hour (2) Assuming heavy vehicle movements are spread evenly over an 11-hour workday					

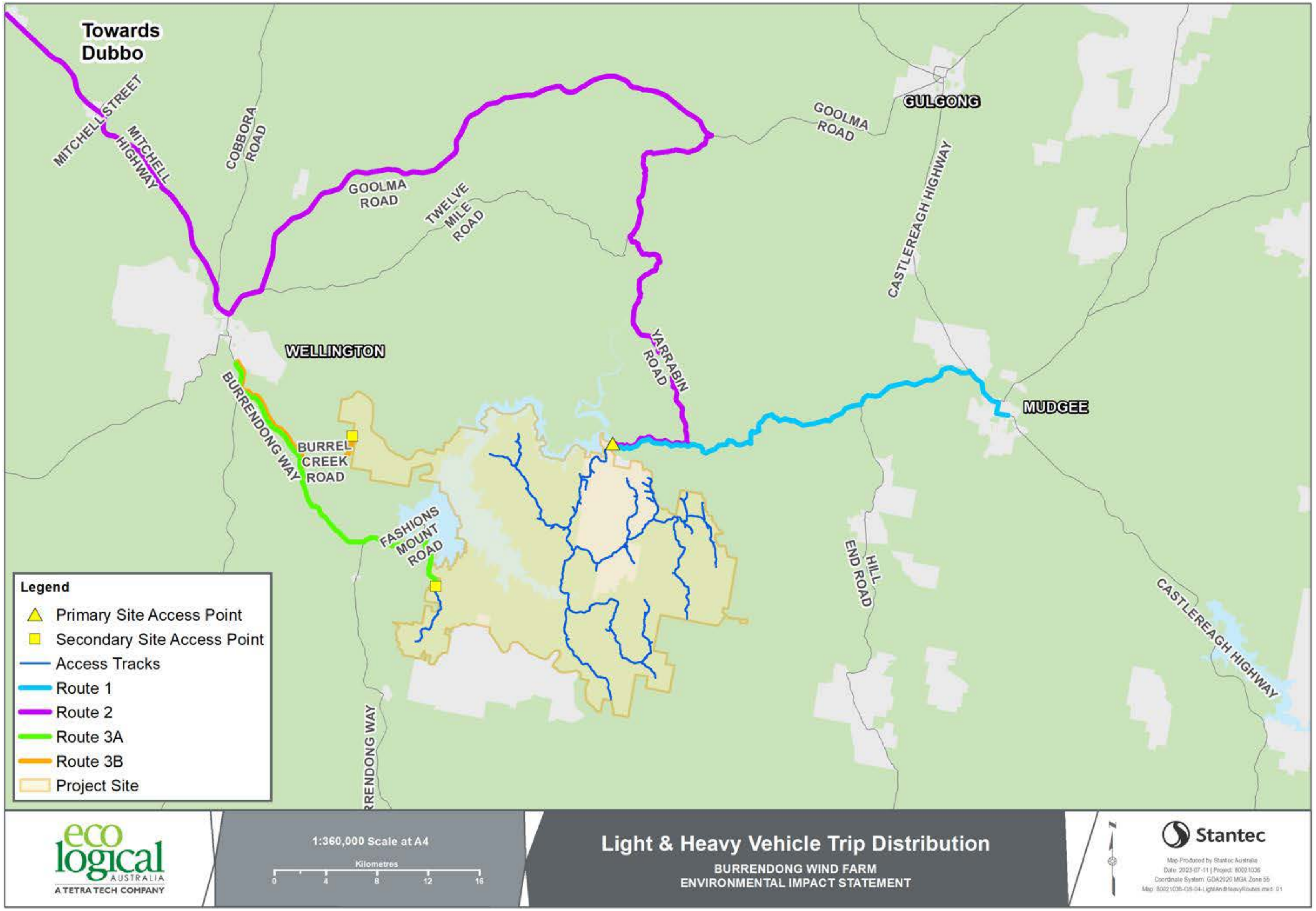


Figure 6-27: Light and heavy vehicle trip distribution (Stantec, 2023)

The thresholds which define two-way rural road capacities are outlined in Section 4.2.4 of the Guide for Traffic Generating Developments (Roads and Maritime Service, 2002). Below is summary of levels of services provide in the Guide:

- **Level of Service A:** The top level is a condition of free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream.
- **Level of Service B:** This level is in the zone of stable flow and drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream, although the general level of comfort and convenience is little less than that of the level of Service A.
- **Level of Service C:** This service level is also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.
- **Level of Service D:** This level is close to the limit of stable flow but is approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor.

Table 6-52 presents the comparison between each road's existing level of service and level of service during the busiest construction months. It should be noted that the existing Level of Service on all roads will not be impacted during peak construction months and each road has enough capacity to facilitate both existing traffic and traffic generated from the Project.

Table 6-52: Existing and future road capacities during construction months 9-10

	Existing Flow Rate (veh/h)	Peak Hour Traffic Generation (veh/h)	Future Flow Rate (veh/h)	Existing LOS	Future LOS
Goolma Road	120	169	169	B	B
Hill End Road	200	273	273	B	C
Burrendong Way	200	214	214	B	C
Twelve Mile Road	14	63	63	A	B
Yarrabin Road	31	104	104	A	B
Burrendong Dam Road	11	133	133	A	C
Fashions Mount Road (3A only)	31	45	45	A	B
Tara Road (3A only)	31	45	45	A	B
Burrel Creek Road (3B only)	11	25	25	A	A

OSOM VEHICLES

The delivery of the WTG components on OSOM vehicles will only occur during months 15-21. To minimise the impact on the road network, OSOM deliveries are likely to be grouped together on particular nights to avoid peak hours and local traffic during the day (subject to Council and TfNSW approval). Similar WTG transportation journeys in the past have occurred between 10 pm – 5 am. On average, there will be four (4) OSOM vehicle journeys on six (6) nights per week over a seven (7) month period. Due to the off-peak timing of OSOM vehicles journeys they are not anticipated to significantly impact traffic.

Railway level crossings are located on the OSOM transport routes, including the level crossing located on Saxa Road (as identified in the SEARs). As the Saxa Road crossing is the nearest to the Site (approximately 1.5 hours away), it is unlikely that light and heavy vehicles generated by the Project will significantly impact the condition of crossings on the OSOM routes. The OSOM vehicle transportation process is a highly controlled process with several escort vehicles leading and trailing behind the OSOM vehicles at relatively low speeds. As typically required post approval, a TMP covering OSOM transportation and consultation with the relevant road authorities will also introduce a level of management and mitigation when traversing level railway crossings. Due to this, it is anticipated that the OSOM vehicles are a low safety risk in traversing over the crossings.

Three intersections located on Route 2A require upgrading to accommodate the OSOM vehicles. This is due to the long rigid nature of the blades they are transporting requiring large turning circles. The following intersection require upgrades:

- Goolma Road and Twelve Mile Road (eastern location)
- Castlereagh Highway and Hill End Road
- Hill End Road and Yarrabin Road.

Upgrades to these intersections are discussed in Section 6.6.3. Some upgrades are also required to accommodate the increase light and heavy vehicles traffic associated to the Project.

6.6.2.3. Operational Impacts

The operational phase of a wind farm is generally between 25-30 years. Routine maintenance is likely to be carried out by 10-15 employees during project operations, typically utilising local professionals or professionals relocating to the region to fill these roles.

Assuming each employee drives themselves to and from the site, the daily traffic generation would equate to 20-30 trips. Inbound trips are likely to coincide with the network AM peak period, whilst outbound trips are likely to coincide with the network PM peak period.

6.6.2.4. Decommissioning Impacts

The decommissioning phase after 25-30 years of operation would conceptually generate a similar or lesser number of trips than the construction phase. This phase would have a significantly reduced workforce and less traffic generation of heavy vehicles. For example, heavy vehicles required for concrete pours during the construction phase will not be required in the decommissioning phase.

Traffic management controls will need to be considered prior to decommissioning commencing to mitigate any traffic and transport impacts. This may include the timing of inbound and outbound heavy vehicle and OSOM trips to avoid network peak periods.

6.6.3. Mitigation Measures

Table 6-53 outlines the proposed measures to mitigate potential traffic and transport impacts.

Table 6-53: Mitigation measures for traffic and transport

Environmental Impact	Mitigation Measure	Reference Code
Public Road Traffic Management	A TMP should be prepared to address the impact of the development on traffic throughout the life of the Project, including the construction, maintenance, operation, and decommissioning stages. The TMP should be	TM001

<table>
<tr><th>Environmental Impact</th><th>Mitigation Measure</th><th>Reference Code</th></tr>
<tr><td></td><td>prepared in accordance with the consent conditions and include the following measures:
• Measures to minimise the traffic safety impacts of the development and disruptions to local road users during construction and decommissioning of the development, including:
o Temporary traffic controls, including detours and signage.
o Notifying the local community about development-related traffic impacts.
o Minimising potential conflict between development-related traffic and stock movements, domestic animals, school buses (in consultation with local schools) and mining related traffic.
o Implementing measures to minimise development-related traffic on the public road network outside of standard construction hours.
o Ensuring development-related traffic does not track dirt onto public road network.
o Ensuring loaded vehicles entering or leaving the site have their loads covered or contained.
o Providing sufficient parking within the Project Site for all development-related traffic.
o Responding to any emergency repair requirements or maintenance during construction and/or decommissioning.
o A traffic management system for managing over-dimensional vehicles.
o Fatigue management.
• Suitable rest stop areas (for OSOM drivers) that are spaced no more than 2 hours apart.
• A Driver Code of Conduct which addresses a detailed program to monitor and report on the effectiveness of these measures and the code of conduct.
• A detailed program to monitor and report on the effectiveness of these measures and the code of conduct.
• Consultation with TfNSW and relevant stakeholders to consider future projects in the region with a similar timeframe to the Project, and the combined impact they may have on traffic management.</td><td></td></tr>
<tr><td>Public Road Traffic Management</td><td>A Stakeholder Management Plan, inclusive of a Communications Plan, is to be developed to provide relevant information to the public, general stakeholders (including Cudgegong River Holiday Park), other major nearby developments and affected landowners. Key stakeholders must be informed of heavy vehicle haulage routes and project progress. Information should be provided in local newspapers, online news, social media, and local radio stations.</td><td>TM002</td></tr>
<tr><td>Internal Traffic Management</td><td>An internal management strategy will be established within the Project Boundary. This strategy will form part of the site's induction that will be undertaken by all personnel on-site. The following key items are to be implemented:
• 40 km/h speed limit on internal access roads.
• Radio communication between construction vehicles available at all times.
• All loads to be correctly restrained.
• Warning signage to be provided at critical areas and intersection points.</td><td>TM003</td></tr>
</table>

Environmental Impact	Mitigation Measure	Reference Code
	The on-site parking within the construction compound is required to provide a dedicated safe area where personnel can access their vehicles. Once a transport contractor has been nominated, they will be required to produce a Job Safety Assessment (or similar) specific to the Project.	
Internal and External Traffic Management	Prior to commencing construction activities, regular and returning drivers of semi-trailers, rigid vehicles and/or B-Double and OSOM vehicles that will access/egress the site for pick-up and delivery of material will be required to undertake a driver induction. The induction will need to be developed early to ensure it is ready prior to construction activity (incl. any site preparation works) commencing. Irregular and one-off drivers of pick-ups and deliveries would be considered exempt to this induction requirement. The course must cover: • Suitable routes to and from the site. • Suitable times of travel (i.e., outside of school bus times). • Applicable traffic management procedures that will need to be in place prior to approaching or departing the site (if required). • Communications and notification procedures. • Speed restrictions (on the road network and the site). • Environmental procedures. • Safety procedures (during transportation and in the evident of an incident / emergency).	TM004
Traffic Management	A nominated contractor will be responsible for liaising with appropriate contractor(s) responsible for delivery of materials to/from the site to ensure that they comply with the TMP, including adherence to specified construction traffic route. It will be the contractor's responsibility to ensure routes are satisfactory and that appropriate measures (traffic management or other mitigation measures as well as liaison with relevant local authorities) are in place to ensure safe movement of vehicles to/from the site.	TM005
Traffic Management	All vehicle access during the construction phase will be via the identified site access locations at Burrendong Dam Road and will use nominated haulage routes.	TM006
Traffic Management	OSOM vehicles will access the site via the identified site access locations and OSOM routes identified by Rex J Andrews Engineering during the Route Study (via Yarrabin Road and Burrendong Dam Road. The OSOM routes are subject to the separate permit and approval processes which will be undertaken by accredited transport providers. Local residents would be informed of such activities via letter drop or by electronic communications at least one week in advance.	TM007
Traffic Management	Carparking must be provided within the confines of the Project Site and must not encroach on the local road network. There will be sufficient area within the site during differing phases of construction to accommodate vehicle parking, including construction traffic deliveries and on-site manoeuvring. A nominated contractor will continually monitor parking provisions within the Project Boundary, as well as the staging of construction vehicles into and out of the Project site, to ensure no impact on the local road network occurs.	TM008
Traffic Management	Construction vehicle signage is to be considered and implemented prior to any works being undertaken. There may potentially be the need to further reduce speed limits on some roads to facilitate safe vehicle access around sites. Appropriate signage will be required in these instances to inform road users. This is to be developed following nominated contractor commission and agreed with key stakeholders.	TM009
Traffic Management	Consultation must take place with Uungula Wind Farm post-EIS approval to ensure that the peak construction months of both wind farms are	TM010

Environmental Impact	Mitigation Measure	Reference Code
	appropriately managed and impacts on the local road network can be minimised.	
Road Upgrade: Goolma Rd / Twelve Mile Rd	The intersection at Goolma Road and Twelve Mile Road must be upgraded to accommodate the OSOM vehicle path. The intersection must be upgraded to include a Basic Right Turn (BAR) this is to accommodate potential for cumulative traffic impacts associated to the construction of Uungula Wind Farm. This in accordance with Austroads Guide to Traffic Management Part 6: Intersections, Interchanges and Crossing Management.	TM011
Road Upgrades	The intersection at Hill End Road and Yarrabin Road must be upgraded to accommodate the OSOM vehicle path. This intersection is considered to only require minor upgrades.	TM012

6.7 Hazards and Risks

Several hazard and risk assessments were undertaken in accordance with the SEARs, which include:

- *Aviation Safety (Aviation Projects, 2023,* Appendix K):
  - *Assess the impact of the development under the National Airports Safeguarding Framework Guideline D: Managing Wind Turbine Risk to Aircraft;*
  - *Provide associated height and co-ordinates for each turbine assessed;*
  - *Assess potential impacts on aviation safety, including cumulative effects of wind farms in the vicinity, potential wake / turbulence issues, the need for aviation hazard lighting, considering, defined air traffic routes, aircraft operating heights, approach / departure procedures, radar interference, communication systems and navigation aids;*
  - *Identify aerodromes within 30 km of the turbines and consider the impact to nearby aerodromes and aircraft landing areas;*
  - *Address impacts on obstacle limitation surfaces; and*
  - *Assess the impact of the turbines on the safe and efficient aerial application of agricultural*

fertilisers and pesticides in the vicinity of the turbines and transmission line;

- *Telecommunications (Middleton Group, 2023, Appendix L) - identify possible effects on telecommunications systems, assess impacts and mitigation measures including undertaking a detailed assessment to examine the potential impacts as well as analysis and agreement on the implementation of suitable options to avoid potential disruptions to radio communication services, which may include the installation and maintenance of alternative sites;*
- *Health – consider and document any health issues having regard to the latest advice of the National Health and Medical Research Council, and identify potential hazards and risks associated with electric and magnetic fields (EMF) and demonstrate the application of the principles of prudent avoidance, including an assessment against the International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines for limiting exposure to Time-varying Electric, Magnetic and Electromagnetic Fields;*
- *Bushfire (ELA, 2023b, Appendix M) - identify potential hazards and risks associated with bushfires / use of bushfire prone land, including the risks that a wind farm would cause bush fire and any potential impacts on the aerial fighting of bushfires and demonstrate compliance with Planning for Bush Fire Protection 2019; and*
- *Blade Throw – assess blade throw risks.*

Assessment Overview

AVIATION

The highest WTG (69) proposed has a ground elevation of 835 m AHD (with a 5 m buffer) and overall height of 1,085 AHD. As this WTG is the highest WTG, the Aviation Impact Assessment determined that all WTGs, including WTG 12, will not exceed 1,085 m AHD and therefore:

- will not penetrate any OLS surfaces;
- will not impact nearby designated air routes; and,
- will not impact LSALT

However, 12 WTGs will impact on the PANS-OPS surfaces by infringing the minimum segment altitude of the initial segment of the RNAV RWY 04 for Mudgee Aerodrome. This will require the approach height at Mudgee Aerodrome to be raised from 3,900 ft to 4,500 ft to ensure safety.

TELECOMMUNICATIONS

The Project is anticipated to have no adverse impacts on infrastructure associated with telecommunication services such as point-to-point communication links, mobile phone service, TV or internet services, nor any navigational equipment (trigonometry stations, GPS, etc.).

The Telecommunication Impact Assessment found that there are no Australian Communication and Media Authority (ACMA) links found within a 2 km buffer of any WTG. Therefore, the Project was assessed as having no impact on ACMA links and no detailed assessment of near-field effects was required. Consultation with the Bureau of Meteorology (BoM) indicated the potential for impacts to occur to the Yeoval weather station. The Proponent and BoM will enter into an agreement of operation that satisfies the BoM's operational requirements.

PUBLIC HEALTH

The electromagnetic fields (EMFs) produced by generating and exporting electricity from a wind farm and associated storage facilities are considered to be of very low frequency and do not pose a threat to public health or contractors and staff.

The shadow flicker assessment undertaken as part of the LVIA (MLA, 2023; Appendix F) confirmed that only two (2) dwellings are expected to experience shadow flicker and that it would not exceed the acceptable level of 30 hours per year. Additionally, only a small extent of Wallawaugh Road has the potential to experience shadow flicker. The low frequency and extensive roadside vegetation is likely to mitigate the impacts to negligible levels. While there is a potential for blade glint to occur, modern WTGs are often constructed with low reflectivity surface treatments to reduce the effect of the glint. This will result in limited potential to impact stakeholders within proximity to the Project.

BUSHFIRE

A risk of a major fire spreading from the Project Site in the direction of Wellington is very low, based on the wind direction associated with significant fire weather being west. Conversely, a major fire spreading from the Project Site in the direction of Mudgee based on a west to south-westerly wind direction and associated weather is technically possible, but also unlikely.

BLADE THROW

The risk of blade throw is considered extremely rare and unlikely however, it has been known to occur previously in operating wind farms in Australia. A study analysing 20,000 WTG towers in Europe and the Americas concluded that the chance per annum of blade throw at any given time (yearly) is approximately 0.0008%. Further studies and research undertaken by the United Kingdom Health and Safety Executive have also indicated that the likelihood of blade failure is in the order of 0.001% - 0.0001%. While the risk of blade throw is unlikely, risks are further minimised through adoption of industry best management practices and regulatory quality assurance systems.

Measures to mitigate potential impacts of the Project are summarised in Section 6.7.3.

6.7.1. Existing Environment

6.7.1.1. Aviation

The land on which the Project is proposed contains elevated ridgelines and stretches of land, with ground elevations at nominated WTG sites of up to 835 m AHD. The construction of WTGs will introduce an additional height of up to 250 m.

AIRSPACE PROTECTION

Pilots may be trained under either the Instrument Flying Rules (IFR) or Visual Flying Rules (VFR). Airports that cater for aircraft that can operate under the IFR are called certified aerodromes. Aircraft landing at a certified aerodrome follow specific safety procedures called instrument approaches. Certified aerodromes have their IFR instrument approach procedures published in the Australian Aeronautical Information Publication and are subject to Obstacle Limitation Surfaces (OLS) and Procedures for Air Navigation Services – Aircraft Operations (PANS OPS), which protect aircraft operations from colliding with obstacles and/or terrain during the critical take-off and landing phases of flight. Certified aerodromes identified near the Project Site are shown in Figure 6-28.

The maximum horizontal distance that an OLS may extend for an aerodrome in Australia is 15 km (8.1 nm) from the edge of a runway strip. As all certified aerodromes are further than 15 km from the boundary of the Project Site, none of the OLS are infringed.

The IFR instrument approach procedures have different segments, and each segment has a minimum altitude that planes must stay above to avoid obstacles (the PAN OPS surfaces). The PANS OPS surfaces are designed beneath the IFR instrument approach and departure flight paths to and from a runway with a prescribed minimum obstacle clearance above the obstacles or terrain. This provides an obstacle-free flight path to enable safe and efficient aircraft operations in Instrument Meteorological Conditions. The Project Site is within the 30 nm Minimum Sector Altitude (MSA) of one certified aerodrome – Mudgee Airport (28 km north-east).

AIR ROUTES

Airspace within the lateral navigation tolerances of an air route is also protected by a vertical buffer above terrain or obstacles to ensure safe flight operations during IFR flight on those routes. Each air route has a published Lowest Safe Altitude (LSALT) which is the lowest altitude that an IFR aircraft can fly without having visual reference to the ground or water. It allows aircraft that can’t maintain height at planned levels due to technical problems to descend to a lower level while maintaining a prescribed margin above obstacles and terrain. The LSALT for each route is determined by assessing the highest terrain or obstacle within each route segment protection area. A minimum obstacle clearance margin of 1,000 ft (305 m) is applied to the highest point and then rounded up to the next 100 ft (30 m) interval. Seven (7) air routes have LSALT protection surfaces overhead or near the Project Site.

AIR TRAFFIC CONTROL SURVEILLANCE SYSTEMS AND NAVIGATION AIDS

Wind farms have the potential to cause both electro-magnetic and reflective type interference to air traffic control (ATC) radar surveillance systems and to the accuracy of aeronautical navigation aids. The nearest ATC radar surveillance system is the Mt Boyce Route Surveillance Radar, located approximately 70 nm (129 km) south-east of the Project Site.

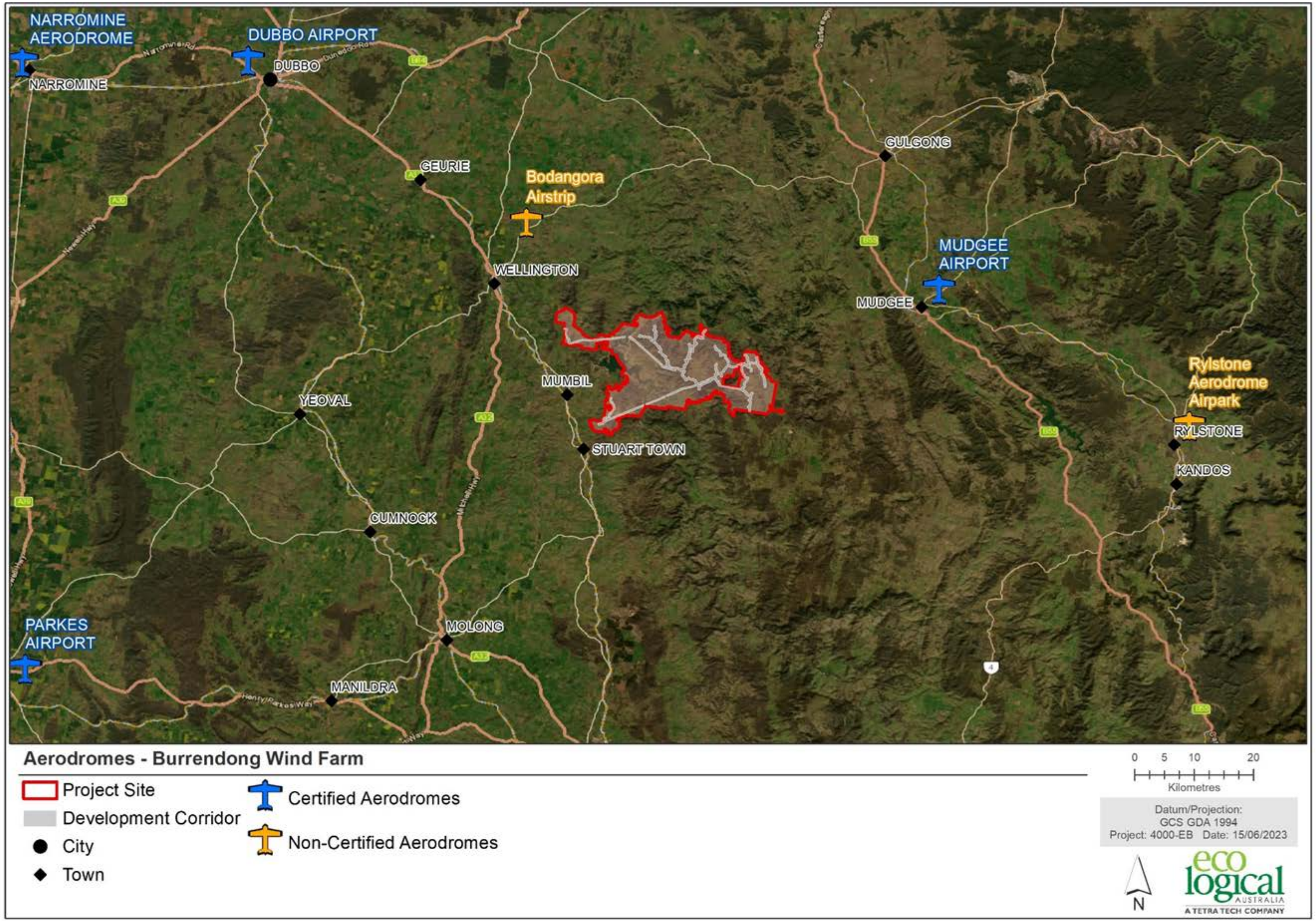


Figure 6-28: Location of certified and non-certified aerodromes in proximity to the Project Site

6.7.1.2. Telecommunications

To assess the potential impacts of the Project on telecommunications, a Telecommunications Impact Assessment was undertaken by Middleton Group (2023, Appendix L). When developing a wind farm project, it is important to understand the existing nature of telecommunication inputs in and around the Project Site to predict impacts and develop appropriate mitigation measures. The impact of the Project has been assessed with respect to the following services:

- Fixed radio communications
- Meteorological radar
- Mobile voice-based communications
- Wireless and satellite internet services
- AM, FM, and digital radio
- Digital and satellite television
- Trigonometrical stations
- GPS.

Electromagnetic signals (radio waves) differ from electromagnetic fields in that electromagnetic signals are used for telecommunications such as radio, radar, broadcast television, and mobile phone networks, and are transmitted across the country. Typically, electromagnetic signals work best when there is a clear line of unobstructed site (LOS) that exists along a path from the transmitter to the receiver. Large structures such as WTGs may introduce interference when they occur close to or in a signal path. The signals can also be interfered with or reflected by the rotating blades and through the generation of the electromagnetic emissions from mechanical generators and machinery. Modern WTG technology and manufacturing regulations from the International Electrotechnical Commission (IEC) have resulted in negligible electromagnetic emissions from WTGs.

Electromagnetic fields are associated with the use of electrical power and are produced by electrical equipment of all sized and voltages but can also occur naturally. This can occur through the build-up of an electric charge during thunderstorms or within the Earth's own magnetic field and are further discussed in Section 6.7.2.3.

POINT-TO-POINT LINKS

The development of WTGs have the potential to impact on point-to-point communication links through three (3) mechanisms. These three mechanisms include:

- Near field effects
- Reflection or scattering effects
- Diffraction

There is one (1) Australian Communications and Media Authority (ACMA) communication link that passes within a 2 km buffer of number of proposed WTGs as shown in Figure 6-29 (Middleton, 2023). The link is the same link previously assessed in 2022, however, the link path has shifted approximately 1 km south and decreased in length by 200 m, from 65.9 km to 65,6 km. The transmitter (Site ID 250574 Burrendong Dam) has moved locations, approximately 1.6 km south which resulted in the link shifting south and changing its bearing. The receiver (Site ID 35200 Mount Bocoble) has remained in its original position. Table 6-54 outlines the single ACMA link that passes through the Project Site owned by WaterNSW.

Table 6-54: Details of the point-to-point link that passes through the Project Site (Middleton, 2023)

BSL/License No.	Site 1	Site 2	Length (km)	Frequency (min)	Owner
496812/2	250574: Burrendong Dam	35200: Mt Bocoble	65.6 km	451.325 MHz	WaterNSW

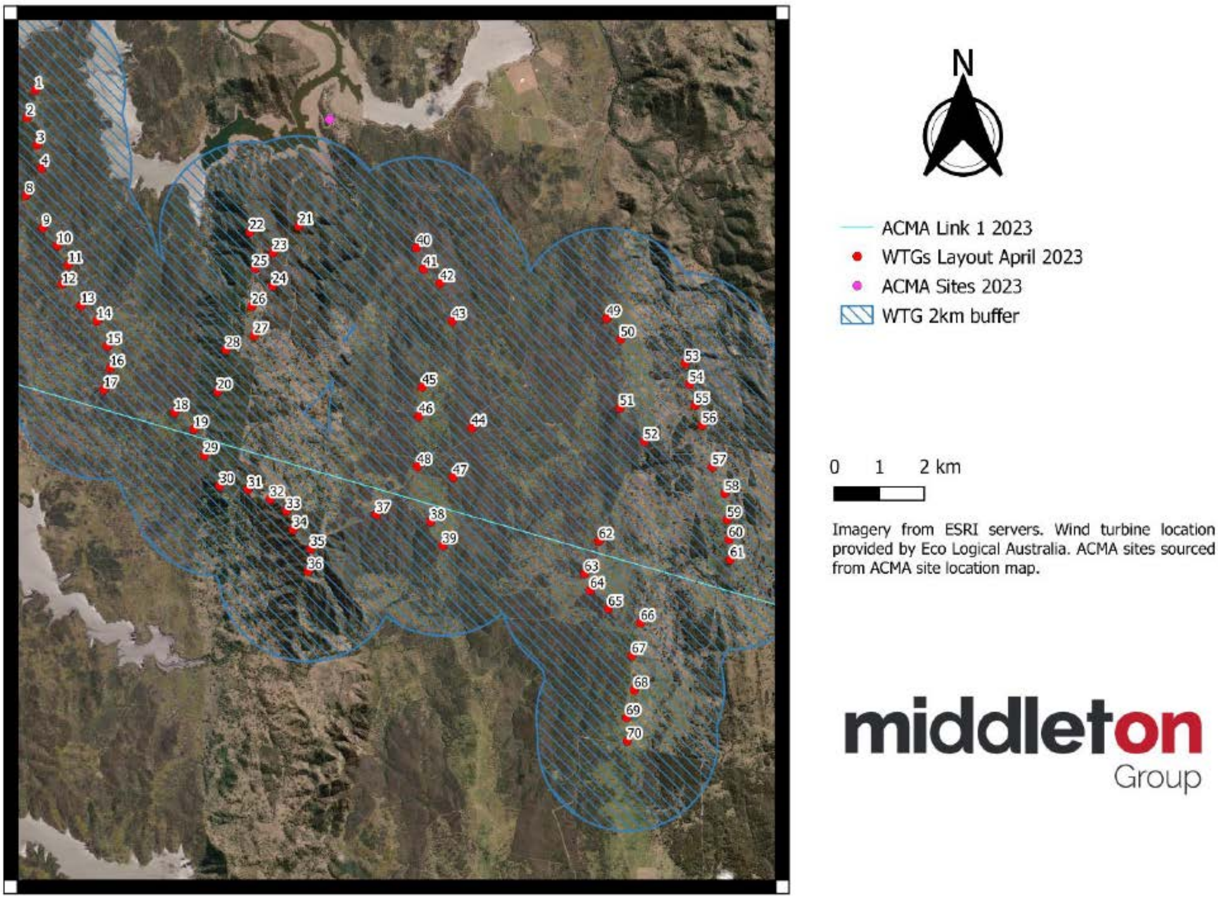


Figure 6-29: ACMA communication site location and link within 2 km boundary of the WTGs (Middleton, 2023)

METEOROLOGICAL RADAR

The nearest meteorological radar to the Project Site is the radar at Yeoval, located 45 km west of the nearest WTG.

MOBILE VOICE-BASED COMMUNICATIONS

There are several mobile phone base stations identified in the vicinity of the Project which provide mobile network coverage from Telstra, Optus, Vodafone and NBN Co. within the region. However, no mobile phone base stations are located within 2 km of the Project Site (Middleton, 2023).

WIRELESS AND SATELLITE SERVICES

There are no WTGs proposed to be located within 800 m of a dwelling, the typical distance that impacts to satellite services might be expected.

TRIGONOMETRICAL STATIONS AND GPS

Trigonometrical stations and survey marks are observation marks used for surveying or distance measuring purposes. GPS antennas and Electronic Distance Measuring (EDM) devices may be installed for some Trigonometrical stations. However, most EDM devices will not be affected by the line of sight obstructions or impaired visibility.

Global Navigation Satellite System (GNSS) networks are operated and maintained across the Australian region and the South Pacific. Based on the GNSS network map provided by Geoscience Australia, no GNSS stations were identified within a 20 km radius of the Project Site (Middleton, 2023).

6.7.1.3. Health (Electromagnetic Fields, Low Frequency Noise, and Infrasound)

In accordance with the SEARs and relevant guidelines, consideration has been given to human health and safety as well as the potential interruption of existing services during the construction, operation and decommissioning phases of the Project.

EMFs are invisible areas of energy associated with the use of electrical power and are sometimes referred to as 'radiation'. Electric and magnetic fields (EMFs) occur simultaneously and are dependent on each other (that is, a change in one will lead to a change in the other). EMFs are produced through the movement of electrons. Electric fields are measured in voltage using volts/metre, while magnetic fields are measured in current using gauss (g) or tesla (T). The strength of EMFs reduces quickly with distance, and while electric fields are insulated to an extent by their surroundings (buildings or the earth in which cables may be buried), magnetic fields are not.

Radiation levels exists across a spectrum from very high-energy radiation to very low-energy radiation. This is sometimes referred to as the electromagnetic spectrum. The electromagnetic spectrum represents all the possible frequencies of electromagnetic energy. It ranges from extremely long wavelengths (extremely low frequency exposures such as those from power lines) to extremely short wavelengths (x-rays and gamma rays).

EMFs are typically categorised into one of two categories based upon their frequency. These are:

- Non-ionizing – low frequency radiation
- Ionizing – high frequency radiation.

Non-ionizing radiation has the energy to excite electrons, with sources including general household items such as microwaves, computers, and power lines. Non-ionizing radiation is generally perceived as harmless to humans, whereas ionizing radiation has the potential to cause damage at a cellular level, to both cells and DNA. Sources of ionizing radiation include sunlight, x-rays, and some gamma rays. Ionizing radiation is potentially harmful to humans.

Australians are routinely exposed to EMFs to varying degrees in their everyday lives. Environmental exposure to man-made electromagnetic fields has been steadily increasing with growing electricity demand, ever-advancing technology, and changes to social behaviours. Within and in the vicinity of the Site, several existing and potential sources of EMF are present including electrical wiring in homes and electrical appliances. In Australia, transmission lines and other electrical devices operate within the range 49.85 Hz to 50.15 Hz and fall within the ELF range of 0 – 300 Hz. The presence of EMF and the magnitude of magnetic or electric fields to humans is known as 'exposure'.

Exposure refers to the circumstance of being in the immediate presence of electric or magnetic field, or having such fields cause electric currents to flow through the body or within the body. Generally, human exposure within the ELF range such as those typically experienced during day-to-day activities do not have perceivable impacts on the human body (ARPANSA, 2015). Potential sources of human exposure within the Study Area resulting from the Project, including proposed transmission lines, are anticipated to be consistent with EMF in the ELF range. Advice from the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA, 2015) indicates that exposure to 50 Hz electromagnetic fields near transmission lines has not been established as a human health hazard, and concludes that where any risk does exist, it would be comparatively small and not warrant any concern (ARPANSA, 2015).

Without Australian Standards for regulating exposure to extremely low frequency EMFs, the NHMRC Interim guidelines on limits of exposure to 50/60 Hertz EMFs have been used to assess the impact of the Project infrastructure (WTGs, battery storage and power lines) to the health of contractors and the public or receptors and are shown in Table 6-55.

Table 6-55: Summary of NHMC's Interim Guidelines on limits of exposure to 50/go Hz EMFs

Exposure Characteristics	Electric Field Strength (kilovolts per m, kV/m)	Magnetic Flux Density (Microtesla - µT)
	Occupational	
Whole working day	10	500
Short Term (max exposure is 2 hours/workday	30	5,000
	General Public	
Up to 24 hours/day	5	100
Few hours/day	10	1,000

6.7.1.4. Health (Shadow Flicker and Blade Glint)

Shadow flicker refers to fluctuating light levels caused within a location that is in the shadow of a moving object. If a location is within the shadow of a moving object, then there will be momentary variations in the intensity of light perceptible from that location as the shadow passes by. Within the meaning of this assessment, shadow flicker refers to the occurrence of this phenomenon as a rotating WTG blade causes intermittent shadowing as the blade passes between the sun and the observer.

Blade glint refers to the ability for light to be reflected from the surface of a WTG blade, which can potentially cause annoyance to an observer. The occurrence of blade glint is dependent on several factors, including orientation of the nacelle, angle of the blade, and the angle of the sun.

Existing sources of glint and glare in a rural landscape include sheds and buildings with high levels of reflectivity from the light rays. The occurrence of reflection and blade glint from modern WTGs is comparatively low as blades are coated in non-reflective paint. Shadow flicker levels in the Draft National Wind Farm Development Guidelines are the appropriate standard for assessing acceptable shadow flicker impact (30 hours per year theoretical, 10 hours per year actual). Stirling McGregor v Tilt Renewables Australia Pty Ltd & Ors 2019 established these guidelines as relevant to other similar scale wind farm developments in Australia.

6.7.1.5. Bushfire and Electrical Fire

The area surrounding the Project Site is modified agricultural land utilised primarily for cattle, sheep, and goat grazing, cropping for stock feed and sheep studs. The vegetation hazard in proximity to the proposed infrastructure is predominately modified grassland with scattered trees and woodland, as well as some isolated areas of forest vegetation. The topography of the Project Site is undulating from approximately 360 m to 850 m in elevation with a range of slope classifications including upslopes to >20 degrees downslopes.

The Orana Bushfire Management Committee area (inclusive of the Dubbo Regional Council) experiences warm to hot summers, that are characterised by temperatures ranging from 17 degrees to 34 degrees, and extremes exceeding 38 degrees for extended periods (OBFRMP, 2021). The mean average rainfall for the area is 500 – 600 mm, with January being the wettest on average. The greatest potential for bushfire events associated with bushfire season usually coincides with north to westerly winds, elevated day time temperatures and low relative humidity between November – February.

Bushfires occur in most years in the region, typically started by accident (including welders, angle grinders, farm machinery, escaped campfires), lightning strikes, powerlines, arson, and escaped permit burns (OBFMC BFRMP 2021). Major fires in the region occur approximately every 10 to 15 years, with 6 major fires recorded in the wellington area between 1975 and 2017. Mapped fire records from 2005 to 2020 were examined and the last 15 years of fire history indicates that there were 17 bushfires within 15 km of the Project Site, ranging in size from 0.1 ha to 218 ha. The collated fire history indicates a generally low number of large bushfire events and an absence of landscape scale bushfires in the locality. The compiled dataset indicates a lower likelihood of bushfires impacting the Project Site, especially larger landscape scale events burning under significantly elevated bushfire weather conditions.

6.7.1.6. Blade Throw

Blade throw describes an incident in which a structural failure occurring in the blade of a WTG during operation results in parts of the blade detaching and being thrown into the surrounding area. Reasons for WTG blade failure may include physical damage to the blade caused by external factors such as erosion or lightning, extreme wind conditions that cause the loads on the WTG to exceed the loads that the WTG has been designed to withstand, material or manufacturing defects, and material fatigue. Similarly, damage caused by a lightning strike may affect the structural strength of the blade. The mechanical stresses experienced by a WTG blade during normal operation and under extreme weather conditions can, over time, lead to weak points or cracks in the material structure, while flaws in the design or materials used may make the blades more susceptible to failure (DNV Energy Systems Renewables Advisory, 2022).

The blade throw assessment describes the blade throw risk zone results for the proposed WTG specifications and cross-references these to existing environmental conditions to identify potential environmental hazards indirectly associated with blade throw.

The Wind Energy Guideline (DPE, 2016a) instructs that the risk of 'blade throw', should be considered when assessing the potential safety hazards from wind farm developments. Relevant considerations may include (but are not limited to):

- whether the proposed WTGs are certified against relevant standards such as IEC 61400-23
- WTG systems – Part 23: Full-scale structural testing of rotor blades or other equivalent standards; evidence of any such certification should be provided.
- Overspeed protection mechanisms including 'fail safe' mechanisms (e.g., back up (battery) power in the event of a power failure).
- Operational management and maintenance procedures including any regular maintenance inspections.
- Provisions for blade replacement in the event a blade fault is identified (e.g., during a periodic inspection).
- The separation distance between WTGs, neighbouring dwellings, and property boundaries.
- The probability of blade throw occurring.
- The location of battery storage facilities and their likelihood to be damaged by potential blade throw.

6.7.2. Potential Impacts

6.7.2.1. Aviation

Terrain elevations at nominated WTG sites vary between 605 m and 835 m AHD. The maximum heights of WTGs will therefore vary from 855 m to 1,085 m AHD (2,805 ft to 3,560 ft above mean sea level). Three (3) permanent meteorological masts up to 165 m tall are also proposed.

AIRSPACE PROTECTION

Pilots operating at uncertified aerodromes need to ensure that they consider local conditions and hazards to ensure that their flight is conducted to the safety standards required under *Civil Aviation Safety Regulation 1998*. The Civil Aviation Safety Authority's *Advisory Circular 91-10 v1.1* states that a 3 nm (5.6 km) distance is 'normally' well outside the circuit area of aircraft operations in the vicinity of an uncertified aerodrome and is where no traffic conflict exists. All validated uncertified aerodromes are located further than 5.6 km from any WTGs of the Project and will not be adversely affected. In visual meteorological conditions, the WTGs will be sufficiently conspicuous to allow adequate time for pilots to avoid the WTGs.

The Project Site is located outside of controlled airspace and is not located in any prohibited, restricted and danger areas. The closest WTG in the Project Site to Mudgee Airport is located approximately 28 km to the south-west and is beyond the horizontal extent of Mudgee Airport's obstacle limitation surfaces. The Project will not impact MSAs for instrument flight procedures at Mudgee Airport.

With the current Project layout, 12 WTGs will impact on PAN-OPS surfaces by infringing the minimum segment altitude of the initial segment of an instrument approach called 'RNP RWY 04' at Mudgee Airport. All other segments and approaches are not impacted. The minimum segment altitude for the initial segment of the 'RNP RWY 04' instrument approach will need to be raised from 3,900 ft to 4,500 ft to ensure safety (Figure 6-30). Currently, there is enough space between the minimum segment altitude (3,900 ft) and the procedure recommended altitude for the approach (4,800 ft), so increasing the minimum altitude to 4,500 ft won't affect the procedure or how planes land. The Mudgee Airport authorities and the airline that operates there have reviewed the changes and confirmed that it won't impact their operations (Aviation Projects, 2023; Appendix K). However, making these changes to the procedures will require additional work and consultation with the relevant authorities.

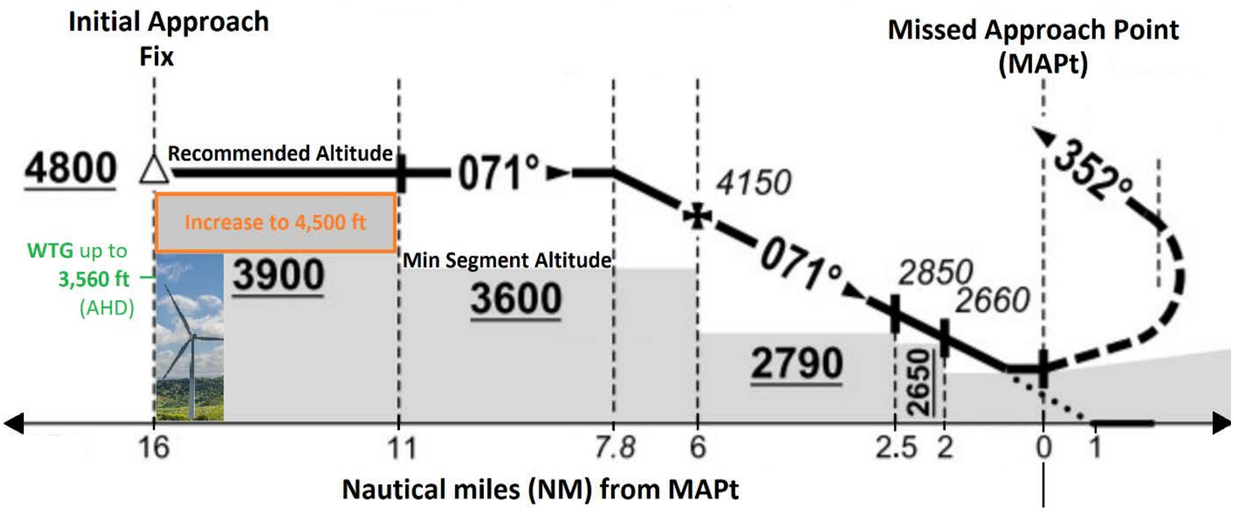


Figure 6-30: Minimum segment altitudes RNP RWY 04 Instrument Procedure (Aviation Projects, 2023)

A potential direct physical impact of WTGs on aviation operations is the turbulence induced by the turning of WTG blades. The turbulence can be potentially noticeable up to 16 times the diameter of the WTG blade down wind of the Project Site. As the Project is proposing WTGs with a rotor diameter of up to 180 m, the potential downwind turbulence could occur up to 2.88 km from the proposed WTGs. However, no identified aircraft landing areas or certified aerodromes occur within the 2.9 km radius of the WTGs and therefore aerodrome operations will not be impacted by wake turbulence effects from the Project.

AIR ROUTES

The highest WTG (WTG69 – 1,085m AHD, 3,560 ft AMSL) is 440 feet (134 m) below the corresponding airspace grid LSALT (lowest safe altitude) protection surface of 5,000 ft above mean sea level, ensuring that it does not affect the grid LSALT.

The Project Site is situated near 7 air routes (Table 6-56). An impact analysis of the air routes reveals no impact from the Project on airspace design or aircraft operations, as the obstacle clearance height (the height above which obstacles would impact on LSALTs or air routes) remains well above the required LSALTs for each route. Therefore, the Project does not pose any obstacles or risks to the air routes in terms of altitude clearance.

Table 6-56: Air route impact assessment (Aviation Projects, 2023)

Air Route and Waypoint Pair	Route LSALT (ft AMSL)	Obstacle Clearance height (ft AMSL)	Infringements of LSALT	LSALT Result
W785 (Mudgi – DU NDB	4,300	3,300	Nil (>10 nm to nearest WTG)	Pass
W717 Bth NDB – Elong	4,700	3,700	Nil	Pass
V295 Sofal – DU NDB	5,600	4,600	Nil	Pass
H66 Kacey – Mudgi	6,100	5,100	Nil	Pass
W731 Panor – DU NDB	5,600 /6,000	4,600/5,000	Nil	Pass
W137 CWR NDB – Mudgi	6,100	5,100	Nil	Pass
UH226 RIC NDB – Enpag	5,500	4,500	Nil	Pass

AIR TRAFFIC CONTROL SURVEILLANCE SYSTEMS AND NAVIGATION AIDS

The Mt Boyce Route Surveillance Radar (129 km south-east of the Project Site) is located beyond the 15 km Building Restricted Area (BRA) specified in National Airports Safeguarding Framework (NASF) Guideline G and therefore no assessment is required (DITRDCA, 2012).

6.7.2.2. Telecommunications

POINT-TO-POINT LINKS

WTGs have the potential to impact on point-to-point communication links through three (3) mechanisms:

- Near field effects: Near-field effects occur in the vicinity of the transmitter and receiver, typically being impacted by objects with inductive fields up to several hundred metres from the transmitter/receiver – though the precise impact is difficult to calculate.
- Reflection or scattering effects: Reflection and scattering relate to the interference by an object that reflects the signal from the transmitter to the receiver. This process creates a longer path between the transmitter and receiver, which can cause undesirable temporal modulation.
- Diffraction: Diffraction is where an object modifies a wave, by obstructing its path of travel. Fresnel zones define envelopes of influence along the length of the ray line, whereby a rotating wind turbine could adversely impact the signal.

The Telecommunication Impact Assessment found one (1) ACMA link transects the Project Site, that being the WaterNSW link between Burrendong Dam (ID 250574) and Mt Bocoble (ID 35200). In point-to-point communications, it is important to maintain a line of sight between the transmitter and receiver free from obstruction. A Fresnel Zone is often considered when assessing impacts between the transmitter and receiver as an elliptical space to incorporate the variation of the waves travelling between points, with objects within the 1st Fresnel Zone likely to adversely impact the signal.

In calculating the paths of the links and the relative impact of obstacles, a clearance threshold of 60% of the 1st Fresnel Zone radius is often considered appropriate for links with lower frequencies, i.e. 400 MHz. This means that obstacles within the 1st Fresnel Zone but not within the 60% threshold are unlikely to impact the receivers. The ACMA link which traverses the Project Site has a frequency of 451.3 MHz and therefore a threshold of 60% of the 1st Fresnel Zone is considered the appropriate separation threshold, which equates to a buffer of 62.7 m. As shown in Figure 6-29, the ACMA link is in proximity to two (2) proposed WTGs (WTG 19 & WTG 62).

Middleton (2023) utilised aerial imagery to determine that the rotor extent of WTG appears to impinge on 0.6 (or 60%) of the 1st Fresnel Zone by 25 m. However, further analysis was conducted and determined that WTG 19 will cause no line-of-sight interference of the link and therefore no impacts are anticipated (Figure 6-31). Additionally, as shown in Figure 6-32, WTG 62 is located outside of the 0.6 threshold of the 1st Fresnel Zone and therefore is unlikely to impact the link.

WTGs along the propagation path can cause an increase in interference due to the combination of diffraction effects caused by the local environment and the WTG, as well as potential reflection/scattering. Notwithstanding the above, it is anticipated that the current siting of WTG 19 will not cause any material impact to the link. Furthermore, consultation with the owner of the link

(WaterNSW) was undertaken and the owner confirmed that the wind farm will not cause any material impact on the link.

Figure 6-31: WTG 19 envelope based on 180 m rotor diameter, relative to the 0.6 threshold of the 1st Fresnel Zone extent of the ACMA Link (Middleton, 2023)

Figure 6-32: WTG 62 envelope based on 180 m rotor diameter, relative to the 0.6 threshold of the 1st Fresnel Zone extent of the ACMA Link (Middleton, 2023)

METEOROLOGICAL RADAR

Meteorological radars detect rain and thunderstorm events, as well as other phenomena such as flocks of birds, smoke, or ash. The BoM radars typically detect rain between 2.5 km to 3.5 km above the ground within a radius of 200 km. Some wind farms show up on meteorological radars as static echoes.

Middleton (2023) undertook a LoS analysis to determine the potential impact of the Project on the Yeoval radar. A digital terrain model with eight (8) WTG paths to the radar were analysed. Additionally, LoS plots for WTG 01, 05, 11, 28, 39, 44, 58, and 68 to the radar were undertaken and determined that there is no direct LoS from Yeoval radar to the WTGs analysed due to the obstruction from the elevation profile. As a result, it is highly unlikely that the WTGs will affect the functionality of the BoM radar.

The level of attenuation associated with idealised knife-edge diffraction has been calculated to be generally more than 50 dB as per Propagation by diffraction (International Telecommunication Union, 2009). Therefore, the level of impact on the Yeoval radar from the Project will be minimal.

Despite the above reduction in potential impact, weather radars are sensitive and designed to cover large areas, and it is possible that some echoes from the WTGs will be detected. These echoes appear similar to precipitation. BoM has expressed some concern about the impact of the facility on the Yeoval radar. As such, the Proponent and BoM will enter into an agreement on the operation of the Project in a manner that satisfies BoM's operational requirements.

MOBILE VOICE-BASED COMMUNICATIONS

All mobile phone base stations are located beyond the 2 km buffer of the Project's WTGs (Figure 6-33). Previous experience suggests that the signal will not be significantly impacted where the towers are located more than 1 km from WTGs. Therefore, the Project is anticipated to have no significant impact on the operation of mobile phone base stations.

In the immediate vicinity of WTGs, some reduction in signal may occur. However, this can be mitigated by relocating the mobile phone receiver in the order of tens of metres. Beyond the Project Site, there will be no significant impact on signal.

Additionally, the Proponent undertook consultation with mobile service providers with respect to the impact on their mobile telemetry services. Both NBN Co and Optus confirmed that the Project will not cause any impact on their mobile telemetry services. No response was received from Telstra or Vodafone in the two weeks from the date of the letter sent (28 July 2021), nor any correspondence at the time of writing the Telecommunication Impact Assessment (Middleton Group, 2023; Appendix L).

Figure 6-33: Proximity of the Project to mobile phone base stations (Middleton, 2023)

WIRELESS AND SATELLITE SERVICES

Satellite services will only be impacted where receivers are sited in extremely proximity to WTGs, impeding their view of the sky. These satelllites typically provide pay-TV, wireless internet, and satellite phone coverage, as well as TV coverage where there is no terrestrial service available.

As no WTGs are located within 800 m of a dwelling, it is highly unlikely that the Project will impact on satellite services.

TRIGONOMETRICAL STATION AND GPS

Middleton (2023) mapped survey marks in the vicinity of the Project as shown in Figure 6-34. Five (5) are within 2 km of proposed WTG locations. While the WTGs will not directly impact on survey marks, should any of the Project's infrastructure interfere with a survey mark, the proponent should engage a registered surveyor to assist with their removal or relocation prior to construction.

For sight navigational purposes, LoS between markers may be obstruction, however moving laterally one to two metres will typically alleviate the blockage. Additionally, WTGs can typically assist in sight navigation, providing a fixed reference point.

Based on the GNSS network map in Geoscience Australia, the EMI impact of the Project to GNSS stations was analysed and found that all GNSS stations except WTON are outside of the Projects 20 km buffer (Figure 6-35). The next closest station is MUDG1, 25 km away. Geoscience Australia confirmed in 2023 that the Project will not cause any impacts on their GNSS services.

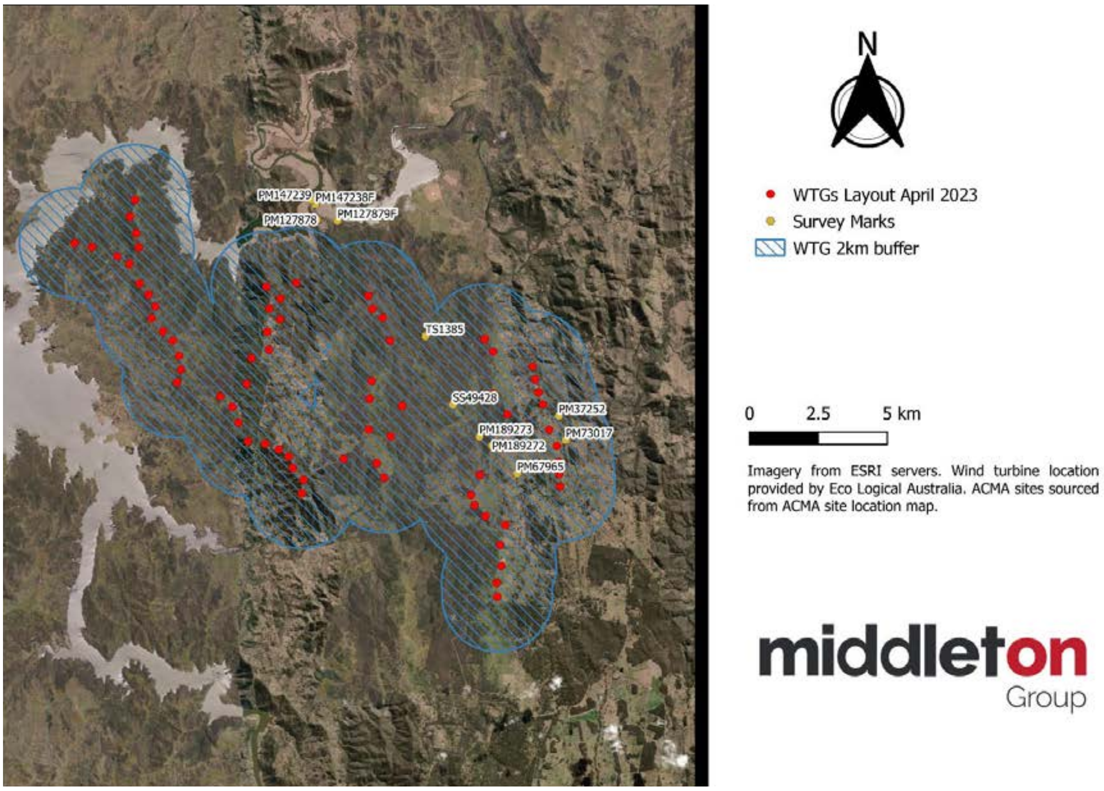


Figure 6-34: Survey marks within a 2 km boundary of WTGs (Middleton, 2023)

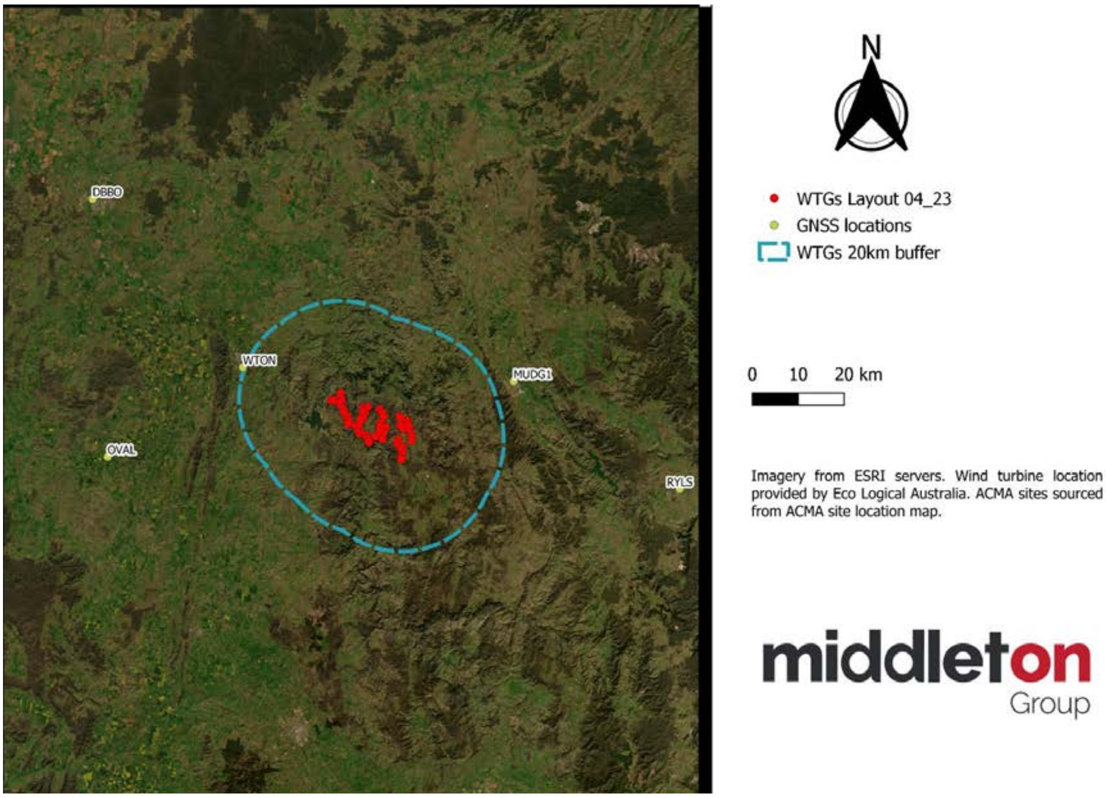


Figure 6-35: GNSS station locations and 20 km WTG buffer (note that WTON station is 20.5 km from a proposed WTG) (Middleton, 2023)

BROADCAST AND DIGITAL RADIO AND TELEVISION

The Telecommunication Impact Assessment found that no AM, FM or DTV transmitters are located within 5 km of a proposed WTG. No digital radio transmitters were identified in the vicinity of the Project Site. Given the typical radius for consultation of 1 to 2 km around AM, FM or Digital transmitters is well exceeded by the Project, no impacts to AM, FM or DTV transmitters are expected as a result of the Project.

TELECOMMUNICATION STAKEHOLDER ENGAGEMENT

Middleton (2023) undertook consultation with key stakeholders as outlined in Table 6-57. A summary of the engagement included the following:

- WaterNSW confirmed in 2021 that the Project will not cause any material impact on their link and provided no comment to the amended layout in 2023 at the time of this report.
- BoM expressed some concern about the impact of the facility on the Yeoval radar, with the Proponent and BoM to enter into an agreement to satisfy BoM's operational requirements.
- NBN Co. highlighted potential issue if RF emission of WTGs are within co bands. Installation of the Project will comply with the *Radiocommunications Act 1992*; therefore the likelihood of interference is very low.
- Optus found no concern with the proposed layout.
- Geoscience Australia found no concerns with the proposed layout.

Table 6-57: List of stakeholder engagement and responses received (Middleton, 2023)

Stakeholder	Impact	Response
WaterNSW	UHF Link (No. 496812/2)	No impact for the Project with old layout (2021), confirmation of receipt of updated layout (2023).
Bureau of Meteorology	Meteorological radar	Potential impact on Yeoval radar; the Proponent and BoM will enter into an agreement.
Telstra	Mobile service operation	*No response*
Optus	Mobile service operation	No impact
Vodafone	Mobile service operation	*No response*
NBN Co.	Mobile service operation	No impact
Geoscience Australia	GNSS Stations	No impact

6.7.2.3. Health (Electromagnetic Fields, Low Frequency Noise, and Infrasound)

Exposure to EMFs would only occur during the operational phase, when the Project is in use and generating electricity. The amount of radiation generated would vary due to the type and size of electrical infrastructure on site and the nature of the equipment. Internal site design and use of perimeter fencing, or protective safeguards would ensure the level of radiation is below NHMRC thresholds and complies with international best practice and regulatory requirements under the ARPANSA Legislative framework.

The EMFs produced by generating and exporting electricity from a wind farm and associated storage facilities are very low frequency and do not pose a threat to public health. McCallum, Whitfield Aslund, Knopper, et al. (2014) determined that magnetic field levels recorded at the base of turbines were low (mean = 0.9 mG), and rapidly diminished with distance from the source, becoming indistinguishable from background levels within 2 m of the base. Furthermore, the proximity of the proposed WTGs to each other and shielding with metal armour effectively eliminates any adverse effects of EMFs from the WTG structures and security fencing would be erected around the substations to restrict all access to potential sources of radiation.

Exposure to EMFs by contractors and staff would be limited to works periods at and around the proposed new high voltage transmission lines and substation on site once they are activated. Knopper, McCallum, Whitfield Aslund, et al. (2014) also measured the magnetic field levels beneath overhead 27.5 kV and 500 kV transmission lines and recorded magnetic field levels of up to 165 µT and 460 µT respectively, which are within the NHMRC guideline levels for occupational exposure within a whole working day (Table NHMRC guidelines).

There would be no risk of exposure to the public or surrounding residents due to the minimum setbacks between the WTGs and associated infrastructure to the public domain. Varying levels of ELF EMFs would be present in the following sources:

- **WTGs:** Magnetic fields produced by the WTGs would be significantly less than those produced for household applications and are indistinguishable from background levels within 2 m of the WTG base (Knopper, et al. 2014). Therefore, the health risk of EMFs from WTGs would be insignificant and pose no risk to human health.
- **Substations:** Substations have the highest variation in magnetic fields, ranging from 0.1 µT to 6 µT at the security fence (EMFs Info, 2020). However, due to the locations of the substations and permissible setbacks in accordance with ARPANSA guidelines, EMF exposure to the sensitive receivers will be below the guideline limits in Table NHRMC. Substation infrastructure is required to increase the voltage of reticulated electricity for transmission to the power grid. Electromagnetic fields around the substation infrastructure would be from overhead lines and underground cables entering the Substation. As has been previously noted, EMF levels are proportional to distance from the receiver, and as such it is unlikely that substations would increase the level of EMF exposure above existing background levels associated with transmission lines existing within the Project Site.
- **Transmission Lines:** A series of underground and overground transmission lines are proposed to transmit electricity generated by the WTGs. Typical electric and magnetic field strengths for overhead transmission lines, including connectors are summarised in Table 6-58.

Cabling may either be overhead or underground, producing EMFs. The magnetic field associated with the lines would be greatest if installed overhead, with approximately 1.7 µT directly below the line diminishing to 0.4 µT at a distance of 10 m. Under the same scenario, the electrical field would be approximately 2.6 kV/m (2600 V/m) directly below the line, diminishing to 0.7 kV/m (700 V/m) within 10 m (EMFs Info, 2020).

The electric and magnetic fields associated with overhead powerlines vary depending on the voltage running through the lines. The intensity of the magnetic field is also relative to the proximity to the transmission line, being the source. The maximum electric and typical magnetic fields produced by the typical voltage transmission lines anticipated at the Project are provided in Table 6-58. The maximum electric and magnetic fields likely to be produced by the transmission lines are below the exposure limits set for contractors and the public in accordance with the NHMRC's Interim Guidelines (Table 53) and do not pose a risk to human health at nearby receptors or within the wider community.

Underground cables do not produce any external electric fields. The typical magnetic field from underground cables is 1 µT immediately above a 33 kV cable buried at a depth of 0.5 m, and 9.62 µT immediately above a 132 kV cable buried at a depth of 1 m. These levels are also below the exposure limits published in the NHMRC's Interim Guidelines. Additionally, given the >2 km distance from the highest EMF emitter (the Substation), and the existing 22 kV local distribution lines located near these residences, EMFs from the Project are likely to be indistinguishable from background levels at all non-involved residences.

Table 6-58: Electric and magnetic fields produced by transmission cables

Transmission Line (kV)	Maximum Electric Field (V/m)	Maximum Magnetic Field (µT)
Overhead Transmission Cables		
33 kV	< 0.85 kV/m	26 µT
132 kV	< 0.85 kV/m	26 µT
Underground Transmission Cables		
33 kV	n/a	1 µT
132 kV	n/a	9.62 µT

All AC electrical equipment that would be used as part of the Project will operate at 50 Hz as per Australian Standards. Generally, household appliances and devices, as well as telecommunication signals operate at much higher frequencies. For example, microwave ovens and Wi-Fi routers operate at 2.4 GHz, while mobile phones operate at 1.8 GHz. As these devices operate at a higher frequency which does not overlap with 50 Hz, and due to the distance at which electrical appliances will likely be located from Project infrastructure, it is unlikely that electrical appliances used by sensitive receivers will be impacted by EMFs from the Project.

6.7.2.4. Health (Shadow Flicker and Blade Glint)

Shadow flicker is defined as the visual effect that occurs when rotating turbines cause moving shadows as the blades pass in front of the sun. The main health concern associated with the occurrence of shadow flicker is the risk of seizures in people with photosensitive epilepsy. However, reviews of existing literature undertaken by Knopper and Ollson (2014), Harding et al. (2008) and Smedley et al. (2010), investigated the relationship between photo-induced seizures and wind turbine blade flicker. These studies suggested that blade flicker that interrupts or reflects turbines at frequencies of >3Hz pose a potential risk of inducing photosensitive seizures in 1.7 people per 100,000 of the photosensitive population. However, for these numbers to be reached by a modern, three-blade turbine, the blades would need to rotate at a maximum speed of approximately 60 rpm. Modern WTGs typically spin at rates far below this threshold. For example, the Vestas V112-3.3 WTG model, assessed within this EIS, is assumed to spin at a rate of 6 rpm[6]. This is well below the necessary blade rotation speed required to potentially induce shadow flicker related impacts on people within the landscape.

Another concern with shadow flicker is annoyance. The number of maximum hours a receptor can be exposed to shadow flicker by a wind farm development is regulated under NSW Planning Regulations put forward in the National Wind Farm Development Guidelines (EPHC, 2010), which state that 30 hours per year (theoretical) and 10 hours per year (actual) are the appropriate standard for assessing acceptable shadow flicker impact. The shadow flicker assessment undertaken as part of the LVIA (MLA, 2023; Appendix F) confirmed that no non-associated dwellings will experience shadow flicker, with the two closest dwellings to a WTG being over 1,000 m.

With regards to potential shadow flicker impact on passing vehicles/motorists, the Draft National Wind Farm Development Guidelines (EPHC, 2010) state that "there is a negligible risk associated with distraction of vehicle drivers who experience shadow flicker". There are only several unsealed minor local roads in proximity to the Project Site due to its isolated nature. The shadow flicker assessment undertaken as part of the LVIA (MLA, 2023; Appendix F) identified a small extent of Wallawaugh Road with the potential to experience shadow flicker. However, the assessment identified the road as having a low frequency of use and extensive roadside vegetation associated that will likely screen views to the WTGs and therefore reduce any potential for motorists to experience shadow flicker along these sections of road to negligible. These roads have a low frequency of use and elements such as roadside vegetation would significantly reduce any potential shadow flicker along these roads. The effects of shadow flicker are similar to the phenomenon created when a vehicle in motion passes a static object e.g., travelling along a tree lined road. Therefore, shadow flicker is not expected to result in significant impacts on passing vehicles given the limited opportunities to view WTGs within a distance where shadow flicker may occur.

Blade glint is caused by the regular reflection of the sun off rotating turbine blades. While there is a potential for blade glint to occur, modern WTGs are often constructed with low reflectivity surface treatments to reduce the effect of the glint, as required by the Visual Bulletin (DPE, 2016b) and will be the case with the Project. This will result in limited potential to impact stakeholders within proximity to the Project as the reflective potential of the sunlight reflecting off WTGs is significantly decreased. Should blade glint occur, it may cause annoyance to people or cause a strobing effect because of turning blades, however this is unlikely to occur.

6.7.2.5. Bushfire and Electrical Fire

IGNITION POTENTIAL

Key risks from the Project on bushfire risk includes several sources of ignition and fuel storage during construction and operation. Earth moving equipment, power tools (e.g., welders, grinders), mowers and slashers are well known for starting bushfires under conditions of high temperature, low humidity,

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[6] This is based on the formula for calculating RPM being (max wind speed x gear ration) / (π x blade diameter), where max wind speed is 25 m/s, gear ration of 90:1 and blade diameter of 112 m. Using publicly available information, the gear ratio for the Vestas V112-3.3 model was assumed to be 90:1 as is the common gear ration in modern WTGs (Bauer GMC, 2018). Additionally, wind speed and blade diameter was sourced from Vestas (2023)

and strong wind. The construction and ongoing maintenance of the Project may utilise this equipment and thus there are potential sources of ignition during the bushfire fire season.

Potential sources of ignitions from the Project include:

- WTGs because of electrical or mechanical faults.
- Fault in a substation or associated powerline infrastructure.
- Structural building fires (e.g., Operations and Maintenance Compound).
- The use of or inappropriate storage of flammable fuels.
- Utilisation of machinery and equipment.
- Land management activities (e.g., APZ maintenance, vegetation management along access tracks or powerlines).
- Construction or maintenance activities (e.g., welding, grinding and other ignition generating works).
- Other anthropogenic sources (e.g., from discarded cigarette butts, cooking fires, fire starts from vehicles or accidents, etc.).

Sharma (2015) found that WTG fires are relatively infrequent, with approximately 50 fires each year out of 300,000 WTGs internationally (a rate of 1:6000). WTG fires have the potential to be an ignition source for a bushfire, particularly where there are:

- Inadequate fire detection systems in place (e.g., control and monitoring systems, heat/smoke detection systems, etc.).
- Little to no onsite fire suppression resources.
- Poorly implemented fuel management practices (APZs, etc) around Project infrastructure.

It is conceivable that arcs or melted components resulting from a WTG fire could ignite grass fuels under or surrounding installations and start a bushfire. However, the level of risk for bushfire associated ignitions starting and then escaping from WTG fires would be of relatively low likelihood, particularly when supported with adequate fuel management zones around these structures (APZ), early onsite detection systems, and available onsite fire suppression equipment is in place.

FIREFIGHTING

The area surrounding the Project Site is mostly limited to landowners, who are predominantly farmers, and the operators of the Project Site. The construction and operation of the Project is not considered to pose a significantly increased bushfire risk to these people, provided appropriate bushfire risk mitigation measures are provided.

However, in the event of a bushfire event, the fire-fighters likely to respond to a bushfire would generally be volunteers from the RFS and or individual property owners. Nearby RFS brigades that would be typically respond to bushfire ignitions in the study area are in the vicinity of Mudgee (Piambong, Grattai, Hargraves, Windeyer, and Lawson-Cudgegong brigades) and Wellington (Mount Arthur, Neurea Seven, Dripston, and Wuuluman brigades). Any fire-fighters from the RFS or neighbouring farms attending such fires may not be equipped with breathing apparatus and are unlikely to be trained in structural and electrical firefighting. However, structural, and electrical fires are considered highly unlikely to occur given the nature of the construction and fire ignition risks. Conversely, they would be more than equipped and trained to respond to ignition in grassland and other vegetative fuels, should this occur.

If the Project is designated by Fire & Rescue NSW as major infrastructure, then Fire & Rescue NSW brigades from the townships of Wellington and Mudgee could respond to any fires relating to the Project. The risks to fire-fighter safety associated with a fire burning the Project infrastructure and associated equipment include inhalation of potentially toxic fumes and smoke from any plastic or rubber components; hydrocarbons or chemicals; or other decomposed products.

A risk of a major fire spreading from the Project in the direction of Wellington is extremely low, based on a west to south westerly wind direction associated with significant fire weather, but is still possible. Conversely, a major fire spreading from the Project in the direction of and reaching the township of Mudgee, based on a west to south-westerly wind direction and associated weather, is technically possible but also extremely unlikely. This is based on the low likelihood of such an ignition occurring, good suppression opportunities, combined with suppression likelihood and impedances to fire development and spread (i.e., fuel breaks, reduced fuel areas, and offensive and defensive firefighting strategies). Despite the low likelihood of bushfire impact, the risk will still warrant mitigation.

6.7.2.6. Blade Throw

Blade throw is a potential public safety hazard involving a rotor blade dropping or being thrown from the WTG structure. In extremely rare incidents, the design load of the WTG structure can be exceeded, which can lead to WTG blades collapsing or being thrown from the tower. This can be a function of improper installation combined with high wind speeds. To mitigate these risks, modern WTGs are designed in accordance with international engineering standards International Electrotechnical Commission 61400 (IEC 61400), which include ratings for extreme weather events such as hurricane strength wings. IEC 61400 is a set of design requirements made to ensure that WTGs are appropriately engineered for potential damage from natural hazards such as hurricane force winds and lightning strike.

CONSTRUCTION IMPACTS

The WTG blades will be delivered to site securely via articulated truck. The risk of blades dislodging from trucks during haulage to the Project Site and during placement is minimal. Once onsite, the blades will be lifted from the truck via crane and using industry best work practices. In the event of winds exceeding the safe use threshold of the crane, works will be shut down.

Stringent quality control procedures will be implemented to ensure that each blade is tracked using a unique serial number from pre-manufacture to erection and testing. Every component of the WTGs will be inspected thoroughly for flaws, defects or inconsistencies and components that do not meet industry standards will be rejected and not used in construction.

Installed components will also undergo inspection and testing by an inspection body that is independent of the construction company or parent company to ensure that testing is undertaken with objectivity against relevant safety standards.

Inspection and Testing Procedures (ITPs) will be initiated and followed and audited during the construction and commissioning phase. Once all testing finds all WTG components including the blades are passed, the WTG will be commissioned for operation.

OPERATIONAL IMPACTS

During WTG operation regular maintenance inspections of all components will be undertaken and reparative activities will be in accordance with the manufacturer's recommendations. Blades will be inspected for micro cracks using up to date best practices. If any cracks above engineering thresholds are detected, the WTG will be immobilised until a replacement blade can be installed.

WTGs will be installed with automatic shutdown governors, triggered by pre-programmed wind speed (e.g., 30 km/hr). During operation, the WTGs will be connected via telemetry to a central control hub via sensors which, if an exceedance of wind speed is detected, will override the system, and shut the WTG down. Once the WTG is shut down, the blade pitch is altered to prevent further spin.

Sensors will have the ability to detect any wobble deflection in the hub, blade or WTG housing indicating mechanical instability and will shut the system down before structural failure or blade throw can occur. The locations of any battery storage facilities have been carefully considered, as blade throw has the potential to cause catastrophic failure of these facilities. Entire blades and blade fragments have the potential to pierce and disrupt battery systems, which depending on the battery type, can cause combustion and/or explosive reactions.

The risk of blade throw is considered extremely rare and unlikely however, it has been known to occur previously in operating wind farms in Australia. EDP renewables (2005) have analysed some 20,000 WTG towers in Europe and the Americas, finding the chance per annum of blade throw at any given time (yearly) is approximately 0.0008%. Further studies and research undertaken by the United Kingdom Health and Safety Executive have also indicated that the likelihood of blade failure is in the order of 0.001% - 0.0001% (MMI Engineering, 2013). While the risk of blade throw is unlikely, risks are further minimised through adoption of industry best management practices and regulatory quality assurance systems. International experience to date has indicated very low risk associated with tower collapse (which is less likely than blade failure), components falling from towers, ice throw, and blade throw.

Extensive literature reviews on blade throw indicate that there are many approaches to modelling blade throw potential, whether theoretical or incident based. This is likely due to the complexity of the analysis, coupled with the extremely low incidence of blade throws reported. Despite this, there is strong similarity in results from both predictive and incidence-based studies providing a robust and reliable framework within which to estimate blade throw and safety risk.

Modelling conducted for the Wild Horse Wind Power project, a similar scale wind energy project (EDP renewables, 2005) presents a simplified worst-case scenario, where loss of a whole blade would occur with the blade rotating at maximum speed when oriented at 45^{o} from the horizontal axis and rising. This is the maximum trajectory case from standard texts as illustrated below in Figure 6-36.

This data indicates that for the maximum WTG failure, blade throw distance is approximately the height of the entire WTG at blade tip height. For example, if the blade tip height is at the worst-case upper tip height of 250 m, the distance a blade is likely to land once thrown is 250 m away from the tower. Research conducted by MMI Engineering (2013) indicates that the likelihood of direct impact from a blade fragment at a distance of twice the tower height is approximately 0.000000009% per year, which is far less likely than being involved in an aircraft accident. If the blade acts as a sail/wing or a downward slope falls away from the tower the distance of landing would be greater; thus, a blade throw buffer zone of 500 m around the tower is recommended.

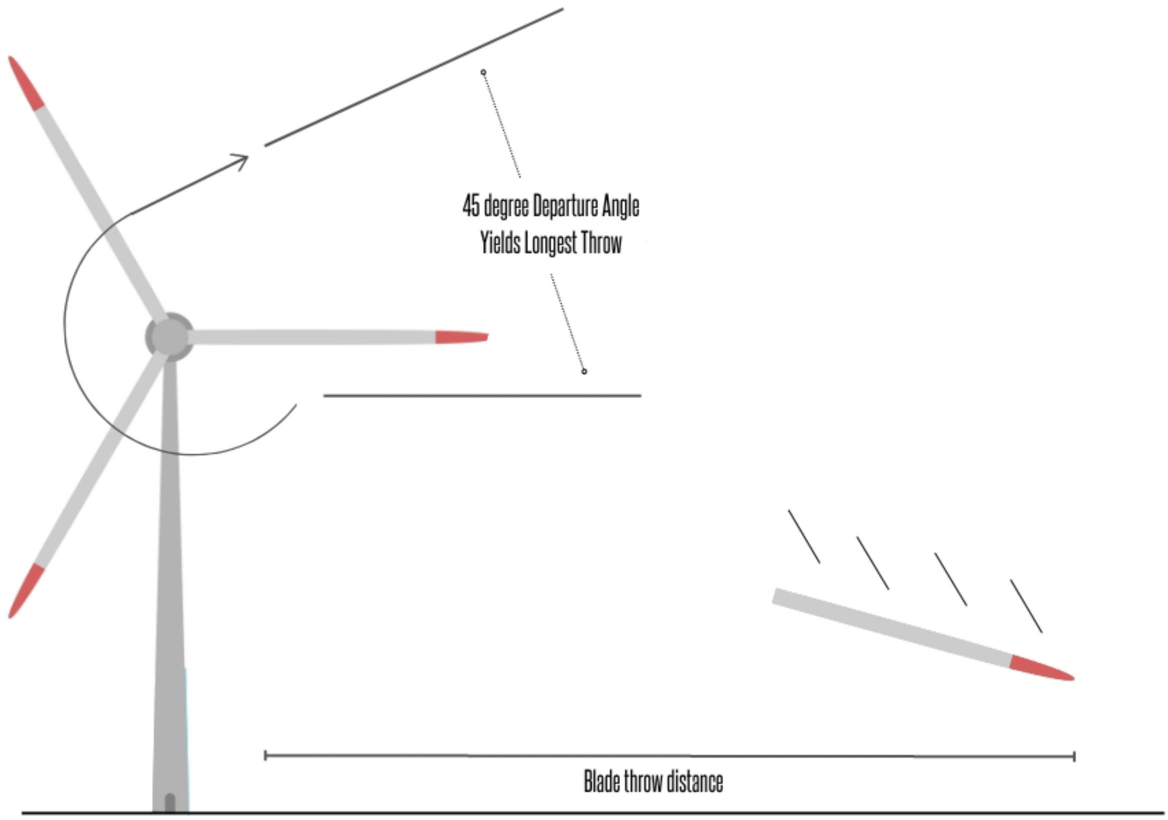


Figure 6-36: Blade Throw Distance (representation based on EDP Renewables, 2005)

Blade fragment throw modelling (where the blade is damaged (such as by lightning strike or bird impact) and breaks apart) has indicated that the risk of blade failure has an extremely low likelihood of occurrence. According to Braam *et al.* (2005) referenced in the Chief Medical Officer of Health's report (2010), the risk of blade failure (including non-throw events) ranges from 1 in 2,400 to 1 in 20,000 WTGs per year (depending on make and quality of manufacture). Maximum reported throw distance documented was found to be 150 m for an entire blade and 500 m for blade fragments (Chief Medical Officer of Health, 2010). This study also demonstrated that WTG throw distance is related mostly to the release velocity of a fragment, rather than the WTG height or blade radius. This suggests that the typical increase in hub height and rotor diameter seen in modern WTG designs will not necessarily relate to a greater potential blade throw distance.

Blade fragment throw distances have also been estimated through use of a dynamic model of blade failure and Monte Carlo simulation techniques (Rodgers *et al*, 2011). Using three WTG models, this study found that theoretical blade fragment throws of up to approximately 530 m for a 3 MW WTG can occur (Rodgers *et al*, 2011). Cotton (2007) estimated impact probabilities at a wind farm site by comparing two methodologies based upon mathematical modelling techniques and risk contours, where blade throw, distances were found to range between 155 m – 205 m from the tower. To model worst case impact, wind speeds equivalent to 1 in 50-year (2% AEP) events were used, and very small blade fragments were considered (10% by surface area/weight). Under these conditions the risk is a 1% chance of a fragment thrown a distance up to 1,500 m.

Based on information from the Caithness Windfarm Information Forum which included 37 reported instances of blade throw, Cotton (2007) established that most blade throw events resulted in fragments being propelled to within 600 m of the WTG location, with only one reported incident of a blade fragment reaching 1,000 m. These studies all demonstrate maximum blade throw distances of between approximately 200 m and 1,500 m, with the throw distance inversely proportional to the size of the object, and more extreme scenarios (e.g., high wind or overspeed conditions) resulting in larger throw distances. The studies also indicate that blade throw distances are not particularly sensitive to WTG dimensions or capacity, meaning that the findings are expected to be relevant for modern WTGs.

There are currently 2 receivers that are located within 1,500 m of a WTG, both of which are associated receivers, being K11-1 and O7-1. Based on the statistics referenced the chance of a blade and/or a fragment impacting on an occupied residence is extremely low, at 0.0004%.

Probability of occurrence is critical to blade throw analysis. The probability associated with the Hazard Zone Distance scenarios modelled for other similar scale projects such as the Wild Horse Wind Power project (EDP renewables, 2005) provides a rational basis for assessing the risks of WTGs within their surrounding environment. Table 6-59 provides the frequencies of occurrence of each described event (tower collapse, blade fragmentation and blade throw) from analysis of incidences reported in German, Danish and Dutch databases.

Table 6-59: Frequencies of occurrence

Scenario	Probability (1/year)
Collapse of entire tower from base	3.2×10^{-4}
Loss of entire blade	8.4×10^{-4}
Loss of blade fragment	2.6×10^{-4}

6.7.3. Mitigation Measures

Table 6-60 summarises the proposed measures to mitigate potential hazard and risks impacts because of the Project.

Table 6-60: Mitigation measures for hazards and risks

Environmental Impact	Mitigation Measure	Reference Code
Aviation	The Royal Australian Air Force (RAAF) is to be advised on the location of the final WTG layout and WTG heights.	AV001
	Notify both CASA and DoD of the Project in accordance with: • CASA Advisory Circular AC 139-08(0) 'Reporting of Tall Structures' to enable the inclusion of the Project location and height of WTGs in relevant aeronautical information publications; and • CASA Form 406 – 'Operational Assessment of Existing and proposed Structures'.	AV002
	Consider the following regarding obstacle marking and lighting: • Paint rotor blades, nacelle and upper 2/3 of the supporting masts of WTGs that are 150 m and over (above ground level) white to contrast against the natural background. • Paint the top 1/3 of the WTG towers / monitoring masts in alternating contrasting bands of colour (white / orange). • Equip WTGs with 2000 candela medium intensity obstacle lights unless CASA agree to the use of 200 candela lighting. • Shield lighting to reduce the impact on residents • Mark and light wind monitoring masts. • Place marker balls, high visibility flags or high visibility sleeves on any outside guy wires • Ensure that the guy wire ground attachment points have contrasting colours to the surrounding ground and vegetation. • Install a flashing strobe light during daylight hours • Install a steady red light during hours of darkness if the WTG tower / monitoring mast is in the vicinity of possible night operations.	AV003
Public Health	Implement appropriate protective measures when exposure in the workplace results in the basic restrictions being exceeded.	PH001
	Undertake engineering controls wherever possible to reduce device emissions of EMFs to acceptable levels. Such controls include good safety design and, where necessary, the use of interlocks or similar health protection mechanisms.	PH002
	In accordance with the ICNIRP (2010) Guidelines, limit personnel access and use audible and visible warnings help to limit exposure to EMFs.	PH003
	Limit access to electrical equipment to qualified personnel only.	PH004
	To mitigate magnetic fields, consider the following in site: • Increasing the distance from the source • Modifying the physical arrangement of the source • Reducing the conductor spacing • Rearranging equipment layout and equipment orientation.	PH005
	To reduce magnetic field reduction from substations, consider the following: • Substation siting • Location and orientation of equipment	PH006

Environmental Impact	Mitigation Measure	Reference Code
	• Busbars and cabling • Location of accessways/buildings. • Locate major magnetic field sources within the substation to increase separation distances. • Minimise fields from incoming and outgoing powerlines • Orient equipment so that magnetic fields are minimized	
	Do not permit unsupervised public access to the Project Site. Landholders or its employees may have access to the Project Site for grazing activities, however there will be no need to spend extended periods near electrical infrastructure.	PH007
	Ensure electrical equipment commissioned as part of the Project is designed to reduce possible interference in line with Australian Standards.	PH008
	Ensure electrical equipment operates at different frequencies to household electrical devices and telecommunication signals.	PH009
Bushfire and Electrical Fire	Develop a Bush Fire Emergency Management and Operations Plan (BFEMOP) in accordance with *Planning for Bushfire 2019* in consultation with the NSW RFS prior to construction commencing at the Project Site and provide the following: • Detailed measures to prevent or mitigate fires igniting • Work that should not be carried out during days of elevated fire danger (e.g., total fire bans) • Availability of fire-suppression equipment, access, and water • Storage and maintenance of fuels and other flammable materials • Notification of the local NSW RFS Fire Control Centre for any works that have the potential to ignite surrounding vegetation, proposed to be carried out during a day of elevated bushfire danger to ensure weather conditions are appropriate • Appropriate bush fire emergency management planning. Two copies of the BFEMOP should be permanently stored at the operations and maintenance facility, one stored at 'Emergency Information Cabinet' at main entrance to Project, and a copy provided to local emergency responders.	BF001
	Construct and maintain an APZ (a minimum of 10 m wide) as the first stage of development for each WTG tower, wind monitoring mast, construction compound, switch yard, substation, and O&M Facility. APZs are to be established and maintained as Inner Protection Areas in accordance with *Planning for Bushfire Protection 2019* (RFS 2019 and Addendum 2022).	BF002
	Should construction or decommissioning of the Project take place during a period of elevated bushfire risk (beginning of October – end of March), the following mitigation measures should be implemented to control the risk of grass fire ignitions: • Keep all plant, vehicles and earth moving machinery clean of any accumulated flammable material (e.g., soil and vegetation) • On days when High (Fire Behaviour Index 24) or worse is forecast for Wellington, check the NSWRFS 'fires near me' app is hourly for the occurrence of any fires with potential to threaten the Project Site and if any are identified activities may need to be modified until the risk subsides. • Cease all operations involving earth moving equipment, vehicles, slashers, hot works (e.g., grinders, welders) and any other works with potential to generate ignitions while the Fire Danger Rating (FDR) is or forecast to be Extreme (Fire Behaviour Index 50) or greater.	BF003

Environmental Impact	Mitigation Measure	Reference Code
	• Put controls in place to avoid or minimise the risk of other anthropogenic ignition sources such as from cigarettes, cooking fires, vehicles. • Ensure all vehicles contain a fire extinguisher and ensure all activities with ignition risk potential have a fire extinguisher readily available nearby and someone trained in how to use it. • Where possible, choose non-combustible hydraulic and lubricant oils. • Handle and store flammable goods on the Project Site in accordance with AS1940-2017. • Promote awareness amongst employees, contactors etc. to prevent all potential fire ignitions within the project Site and especially on days of elevated fire danger and / or Total fire ban.	
	Identify and marking of meteorological masts and guy wires to minimise the risk to aerial firefighting operations.	BF004
	Consider opportunities for the provision of additional water supply and fire suppression equipment on-site.	BF005
	To reduce the likelihood of WTG fires, consider installing the following: • Lightning protection. • Heat barriers to protect combustible elements onsite. • Heat and/or smoke detection systems, for early notification of fires. • Suppression systems, either water or foam that can contain a fire.	BF006
	Except for emergencies, suspend Project Site maintenance operations that pose an increased ignition potential on days of elevated fire danger ratings where the FDR has a Fire Behaviour index of 24 or worse (higher).	BF007
Blade Throw	Ensure WTG components are manufactured and certified to current best practice Australian and international (IEC 61400-23) safety standards and are equipped with sensors that can react to any imbalance in the rotor blades and shut down the WTG if necessary.	BT001
	Ensure WTGs are subject to stringent safety and security measures including regular maintenance and servicing (within an ISO90001 Quality Assurance system).	BT002
	Employ contractors certified in the manufacture, delivery, build, inspection, maintenance, and repair of WTG components.	BT003
Telecommunications	Avoid locating construction equipment closer than 500 m from dwellings. If unavoidable, locate equipment away from the receiver.	TC001
	Prior to construction, locate all survey marks within the Development Corridor. Establish no-go areas to ensure survey marks are not disturbed. Where survey marks are required to be moved, engaged a registered surveyor for advice.	TC002
	Consult with NSW Government Telecommunications Authority regarding possibility of knife-edge diffraction on communication link.	TC003
	Prepare a contingency plan for emergency communications in the vicinity of the WTGs that includes a plan for mobile signal interference such as the relocation of mobile phone receivers in the order of tens of metres.	TC004
	Where television signals are impacted on nearby dwellings, adjust the antenna.	TC005

6.8 Aboriginal Heritage

An Aboriginal Cultural Heritage Assessment (ACHA) has been prepared by ELA (2023c, Appendix N). The assessment has been undertaken in accordance with the requirements of the SEARs, which include:

- *Assess the impact to Aboriginal cultural heritage items (archaeological and cultural) in accordance with the Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH, 2011) and the Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW (DECCW, 2010), including results of archaeological test excavations (if required)*
- *Provide evidence of consultation with Aboriginal communities in determining and assessing impacts, developing options, and selecting options and mitigation measures (including the final proposed measures), having regard to the Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010) including results of archaeological test excavations (if required);*

Assessment Overview

The Project Site is located on the Traditional Lands of the Wiradjuri People, who have a continuous connection to the land. An Aboriginal Cultural Heritage Assessment (ACHA) was conducted by ELA (2023c) to assess the existing state of Aboriginal culture, sites and artefacts within the Project Site and the potential impacts to matters of Aboriginal Cultural Heritage because of Project works. The ACHA was conducted in accordance with the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* and the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW.*

The ACHA involved the surveying of areas of the Project Site, primarily areas involving proposed Project infrastructure or that would have likely experienced significant Aboriginal occupation such as watercourses. The results of the survey effort uncovered several Aboriginal locales and/or artefacts, with the majority found to contain nil to low overall significance. No intangible cultural values have been identified within the development footprint. It is recognised that the surrounding area has high social and cultural values associated with the Macquarie River and resources within the landscape.

A total of 36 survey units were traversed. While there is likely to be direct or indirect impacts to most survey units, the impacts were assessed as likely to result in no or partial loss of value as a result.

A total of 102 Aboriginal object sites were identified, with thirty-five (35) being identified within the Development Footprint and potentially impacted by the Project. Most sites have generally very low density and shallow soils and disturbed context such that there are no potential archaeological deposits. The identified sites within the development footprint will be registered on AHIMS. Six (6) Aboriginal sites (BWF AS10, AS11, AS14, AS38, AS86 and AS88) were assessed as having moderate to high overall significance.

Mitigation measures have been proposed to mitigate potential impacts of the Project in Section 6.8.3.3

6.8.1. Existing Environment

6.8.1.1. Environmental Context

An understanding of the physical landscape and environment is vital to understanding the archaeology of an area. The availability and distribution of resources influenced past land use. People need access to resources of freshwater and foot, plants for medicinal use, timber for woodworking and quarry sites for tool manufacture.

Since the time of Aboriginal occupation, the environment and resources in many places is likely to have changed. As such, archaeologists cannot always draw direct inferences from the current environment. Historical land use and environmental degradation have impacted on the survival of material remains. Acidic soils, if present, are less likely to have preserved fragile organic materials such as bone or shell. Areas of heavy erosion, some agricultural practices or other earth disturbances are less likely to contain in situ deposits of archaeological material. These factors need to be considered when undertaking archaeological assessment and predictive modelling.

The Project Site is situated within the Southwestern Slopes bioregion of NSW. The Project will be located along the elevated ridgelines and crest that have been heavily dissected by drainage lines. The landform is undulating ranges with narrow ridges alternating between peaks and saddles and long broad spurs branching off from the ridgelines. The slopes are moderate to steep, with undulating plains between ridges. The geology of the Project Site is dominated by silicious volcanics, occasional basalt caps, intrusive granite slopes and valleys with folded and faulted sedimentary sequences. The Project Site covers six (6) soil landscapes, Mullion Creek (mu), Mookerawa (mk), Burrendong (bd), Collingwood (cg), Erudgerie (er) and Red Hill (rh). The characteristics of these soil landscapes are outlined in Table 6-61

Table 6-61: Soil landscape characteristics of the Project Site

Soil Landscape	Characteristics	Erodibility
Mullion Creek (mu)	Mullion Creek soil landscape occurs on undulating low hills often strewn with quartz gravel. Characterised by mainly red podzolic soils on crests and upper slopes, yellow soloths and yellow solodic soils on mid to lower slopes and in drainage lines. There is a moderate to high erosion hazard and moderate acidity which does not present a high likelihood for the preservation of organic material. PH levels are neutral (6-6.5).	This soil landscape has moderate to high erodibility and are shallow on slopes. Lower slopes and depressions have the potential for slightly deeper soil profiles but can be subjected to severe gully erosion. This soil landscape has limited potential for in situ archaeological deposits to be present.
Mookerawa (mk)	Mookerawa soil landscape occurs on undulating to rolling low hills with slopes 8-30%, but generally less than 15%. Sheet erosion occurs on the lower slopes and there are copious quartz gravels. The geology of the soil landscape is characterised by slate, greywacke, shale, acid and siliceous volcanics. Yellow soloths and solodic soils occur on lower slopes and drainage depressions. Red podzolic soils occur on upper slopes and crests and some shallow, brown loams and sandy loams occur on some crests. PH levels are neutral (6-6.5).	This soil landscape has a high erosional hazard indicating a limited potential for in situ archaeological deposits to be present.
Burrendong (bd)	Burrendong soil landscape is found in scattered areas between Wellington and Mudgee and in some north-west to south-east trending ridges in the vicinity of Burrendong Dam. Characterised by rolling to steep hills with slopes ranging from 20-50%. Rocky	This soil landscape has moderate to high erodibility and are often skeletal or absent due to slope with rock outcropping. This soil landscape has

Soil Landscape	Characteristics	Erodibility
	outcrops are common, and the soils are shallow, red podzolic soils on mid-slopes and yellow solodic soils occur along drainage lines. The soils are hard setting and often very stony and skeletal due to the slope and high erodibility. PH levels 5.5 to 7.0 which ranges from slightly acidic to neutral.	limited potential for in situ archaeological deposits to be present.
Collingwood (cg)	Collingwood soil landscape occurs on slopes and is characterised by red podzolic soils on upper and mid slopes, yellow podzolic soils on lower slopes and brown soils on crests drainage lines. There is a moderate to high erosion hazard when there is cultivation practices and low vegetation cover PH levels are neutral.	This soil landscape is located on slopes sufficient to have high to very high erodibility and are shallow This soil landscape has limited potential for in situ archaeological deposits to be present due to the fragile structure and high erodibility under the current pastoral use.
Erudgerie (er)	Erudgerie soil landscape occurs on undulating low hills of shale and sandstone. Characterised by yellow and red podzolic soils on mid and lower slopes with shallow brown soils on upper slopes. Alluvial loams on broad flats, large amounts of ironstone gravels present on the surface and within the A2 horizon. Slopes are less than 5% which reduces the erosion hazard, but the erosion hazard is still moderate to high when the soil is cultivated, or surface cover is low. PH levels are acidic on the surface.	This soil landscape is susceptible to soil structure degradation and erosion hazards meaning they tend to be shallow This soil landscape has limited potential for in situ archaeological deposits to be present, any evidence of Aboriginal occupation would be a surface expression.
Red Hill (rh)	Red Hill soil landscape occurs on rolling hills of Andesite, tuff, shales, greywacke and limestone. Characterised by rocky outcropping and brown shallow soils. The surface soils are susceptible to structure degradation under cultivation and heavy grazing.	This soil landscape has limited potential for in situ archaeological deposits to be present due to shallow to skeletal soil profile.

ETHNOHISTORY

Aboriginal people have occupied NSW for more than 42,000 years, utilising the natural resources available to them (Bowler et al 2003). The Southwestern slopes region was the traditional country of the Wiradjuri speaking peoples who encompassed a wide area of inland NSW, extending between the Macquarie, Lachlan, Murrumbidgee, and Murray Rivers, within the regions of Dubbo, Wellington, and Mudgee (O'Rourke, 2009). The Wiradjuri people travelled to the alpine regions for annual summer feasts of Bogong moths and utilised the resources of the rivers which supplied a variety of consistent and abundant food, including shellfish and fish. This was supplemented in dry seasons by hunting for emus and possums and gathering fresh food like yam and other vegetables. The Wiradjuri people generally moved around in small groups, using river flats, open land, and waterways throughout the seasons. Major water courses were a vital part of a groups territory as it not only provided abundant resources but also served as a ceremonial meeting place (O'Rourke 2009).

It is estimated that around 10,000 Wiradjuri speaking individuals occupied the land comprising of the Project Site at the time of European invasion, though this is hard to ascertain as limited information remains pertaining to the patterns of movement of the Wiradjuri people over the course of the year (Macdonald 2011). Early explorers and settlers noted variation in the numbers of Aborigines that would gather for food procurement in the area during the different months of the year (Haglund 1985). In 1817, John Oxley, the first European to travel up the Macquarie River from the Wellington Valley, observed an 'abundance of fish and emus, swans, and ducks' along the river (Dibden, 2011). He observed in the warmer month's large groups of Aboriginals of several hundred people would come together on one stretch of a major watercourse to exploit the fish, yabbies, and mussels. Fish net traps were made from the fibre of the Kurrajong bark. Short excursions away from the rivers and major creeks gave them access to the 'woodland foods' such as possums and honey while the women would also gather plant foods. A very important grass seed, ground on grindstones and cooked in the form of tiny loaves or cakes (O'Rourke 2009).

An accurate reconstruction of past lifeways, technologies and land-use patterns of pre-colonial era First Australians can be flawed as it is often dependant on historical documents written by Europeans who held an ethnocentric bias concerning complex traditional cultures that they did not fully understand. When possible, Aboriginal oral history is an invaluable resource in understanding the past. Archaeological investigations, in conjunction with both Aboriginal oral history and European documentation, can inform these gaps in our understanding, and in many cases challenge the biased notions of early colonial accounts.

The first recorded contact between Europeans and the Wiradjuri people was in 1813 and initial relations between Europeans and the Wiradjuri are thought to have been amicable. This changed after 1821 when Governor Brisbane expanded the limits of the settlement, resulting in an increased population and large numbers of cattle and sheep. As a result, traditional land use practices shifted and interfered with access to social and sacred sites (Connor 2002). Soldiers and settlers made 'sweeps' on the Indigenous populations in 1824 and clashes between the settlers and local Aboriginal people became commonplace (O'Rourke 2009).

LAND USE HISTORY AND ABORIGINAL MATERIAL EVIDENCE

The Project Site has been primarily used for stock grazing with limited timber getting. The majority of the Project Site and surrounds have not been extensively cleared likely due to the steep terrain and unfavourable prospects for agriculture cultivation. The gentle slopes, gullies and open valleys have been cleared with remnant trees and stands of woodland left to promote pasture and grazing.

The proposed location of the WTGs will be on the ridges and spur crests which are typically rocky and highly exposed to the elements which would have been unfavourable occupation locations. They would have likely been utilised for hunting gathering and as a means of travel through country. The steep slopes, rocky outcrops and skeletal soils would have supported a low biodiversity and there are limited water sources to support long term sustainable occupation. The rocky outcropping of basalts, and quartz would have been a desirable resource for stone tool manufacture. The evidence of Aboriginal utilisation is likely to be very low-density sites along ridgetops, ridgelines, and saddles. There are potentially moderate density sites near stone quarry/ resource points with access to springs and sheltered from the elements.

The lower slopes, drainage lines and valleys between ridgelines would have been the focus for occupation due to the higher diversity of resources, had reliable water sources and would have provided protection from the elements. These areas are likely to have moderate to high density sites reflecting longer term occupation and utilisation of the environment. The Aboriginal sites will likely be higher density near major water courses. Due to the past land use many of the Aboriginal sites have likely been impacted by land clearance and stock erosion on the lower slopes and valleys adjacent to creeks. The shallow and skeletal soils on the upper slopes and ridgelines means if sites are present, they will likely be on the ground surface and can be located if the visibility is favourable.

6.8.1.2. Archaeological Context

AHIMS RESULTS

The Aboriginal Heritage Information Management System (AHIMS) is a database maintained by Heritage NSW and regulated under Section 90Q of the NPW Act. AHIMS holds information and records regarding the registered Aboriginal archaeological sites (Aboriginal objects, as defined under the Act) and declared Aboriginal places that exist in NSW. An extensive search of the AHIMS database was conducted on 9 March 2021 (search ID 574648) to identify if any registered Aboriginal sites were present within, or adjacent to, the Project Site. The AHIMS search parameters are shown in Table 6-62.

Table 6-62: Search parameters for the AHIMS database search

Search Parameters	
GDA Zone	55
Eastings	691578 – 725578
Northings	6365627 - 6399627
Buffer (m)	0 m

The AHIMS search resulted in 104 Aboriginal sites and no Aboriginal places being previously identified within 30 km of the Project Site. The total of 104 sites included 10 sites that were outside of the study area, while the remaining 94 sites were located within the assessment area of the survey effort and were included for assessment as represented in the table below. The site types identified are listed in Table 6-63.

Table 6-63: Type and number of sites found within 30 km of the Project Site following AHIMS search

Site Type	Number of Sites	Percentage of all Sites (%)
Artefact	79	88.4%
Artefact/ Stone Quarry	4	4.3%
Artefact/ Hearth	3	3.2%
Artefact/ Hearth/ Burial	1	1.1%
Water Hole	1	1.1%
Modified Tree	1	1.1%
Modified Tree/ Burial	1	1.1%
Stone quarry	3	3.2%
Ochre Quarry	1	1.1%
Total Number of Sites	**94**	**100%**

Most Aboriginal sites within the search parameters are artefact scatters or isolated finds (88.4%). On 13 April 2021, AHIMS and Mudgee LALC was contacted to seek information regarding the location of the Restricted Sites, and whether they would be impacted by the proposed works. It was confirmed that

AHIMS ID 36-5-0192, AHIMS ID 36-5-0197 and AHIMS ID 36-5-0196 are not located within the Project Site. Further information regarding the remaining five (5) sites is pending but it is unlikely they are located within the Project Site as no previous assessments or access to the site has been made.

No Aboriginal sites have been identified by the AHIMS search being located within the Project Site. The sites identified in the wider region reflect what is potentially located within the Project Site and can inform a predictive model for the assessment.

6.8.1.3. Archaeological Survey

The purpose of the archaeological survey is to assist in identifying the existing and potential Aboriginal sites located within the impact area that have not been previously recorded. This archaeological investigation proposes to conduct a sample survey of the areas of proposed development to understand the presence, nature, extent and inform significance of the archaeological resource.

SURVEY STRATEGY

A preliminary survey was undertaken as part of the Scoping Report for the Project in 2020 and aimed to inform the ACHA survey. The field survey for Aboriginal areas, objects and places was conducted in May, June, and October 2021. The Project Site contains three of the four landforms defined as archaeologically sensitive by the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (DECWW 2010) which indicates the following landforms to be archaeologically sensitive:

- Within 200 m of waters – large portions of the Project Site are within 200 m of water.
- Located on a ridge top, ridgeline, or headland – the proposed WTG locations will be located along ridgeline and ridge tops.

A predictive model for identifying Aboriginal sites and the likely size density and significance of sites was based on numerous archaeological surveys conducted in the wider region. The predictive model identified that surface and sub-surface stone artefact scatters would be the most common site type found. Therefore, the survey targeted areas of ground surface exposure to determine if stone artefact scatters were present as well as identifying landforms with PAD which might contain sub-surface stone artefact scatters. These site types are likely to be located on flat to gentle sloping surfaces. Steep slopes were sampled as the gradient is likely to be subject to high levels of erosion and is unlikely to contain evidence of Aboriginal objects. For consistency the same predictive factors were addressed to build a landscape context within the survey units.

The archaeological survey was conducted on foot and aided by vehicles to traverse the expanse of the Project Site. Most of the proposed impacts for access tracks within the footprint will cover areas heavily disturbed by existing graded vehicle tracks, survey across these areas were sampled, in accordance with the Code of Practice. A handheld Global Positioning System (GPS) was used to track the survey area covered and record the location of key features (disturbances, areas of archaeological sensitivity/potential). The coordinate system projection used for all site recording was GDA94 MGA 55. Landforms that were assessed included:

- **Ridgeline** – a chain of hills or peaks that form a continuous elevation for some distance. The ridgelines are narrow along the top with sloping sides either steep or moderate. The peaks and hills are joined by saddles that can be narrow with steep slopes or broad and shallow. Characteristically have high rock out cropping occurrences.

- **Crests** – area similar to ridgelines in that they are elevated in the landscape, however they are broad convex features that have an overall gentle to moderate sloping gradient.
- **Flats or open depression** – is the large gently sloping or flat areas at the lower elevations or upper elevations between ridgelines. They are often dissected by creeks and are often disturbed from farming/ agriculture activities.
- **Slope Gradients** - Very gentle 1-3%, gentle 3-10%, moderate 10-32% and steep is greater than 32%.

SURVEY RESULTS

The field survey of the Project Site involved sampling and 36 Survey Units were traversed on food and by vehicle. The majority of Survey Units are located along the ridgelines and broad long crests within the assessment area, many of the access tracks proposed for the wind farm will be located on the top of these landforms connecting the WTG pads. The watercourses which drain the landforms are mostly low order streams. In proposed turbine areas, these are 1st order and, accordingly, ephemeral and are unlikely to hold water, even immediately after rain. Given the absence of any obvious potable water in these proposed activity areas, it is predicted that Aboriginal land use would have been restricted to activities such as hunting and gathering forays, conducted away from base camps and areas of more permanent habitations. The nature of such activities as such, that low to very low-density sites would occur. Artefact complexity may also be generally restricted, reflecting the limited range of activities being undertaken in such areas. The description of the Survey Units is provided in Table 6-64.

The landscape can be summarised as rocky and steep along the upper elevations with gently sloping, shallow soils across open depressions near drainage lines and creeks. All soils were shallow or absent with limited potential for sequenced archaeological deposits, a few pockets of deep soils were exposed along Little Oakey Creek. It is likely that artefact densities may not be from single events but an accumulation from multiple occurrences. Due to the shallow soils and rocky nature of the entire study area it is considered an effective predictive model can be made from the distribution of Aboriginal evidence. It is considered an effective coverage of the Project Site was undertaken.

Aboriginal objects were identified across most landforms where there was high visibility and exposed deposits. Low density artefact scatters were identified along the ridgeline and crests near stone sources and on sheltered saddles. High density artefact sites were identified across areas of high exposure within the open depressions near reliable water sources.

Table 6-64: Survey Unit description summary

Survey Unit	Landform	Geology	Soils	Vegetation	Geomorphology	Disturbance
SU1	Ridgeline – narrow crest with steep side slopes, peaks, and saddles	Uplifted Sedimentary – shales with volcanic outcropping	Skeletal to shallow brown loams	Open woodland partially cleared for grazing, sparsely grassed	Eroded – sheet, human and animal	High disturbance -grazing, clearance, track grading and natural erosion
SU2	Ridgeline –steep side slopes and saddles	Uplifted Sedimentary – shales with volcanic outcropping/ seams	Skeletal to shallow brown loams – shattered rock and gravels	Open woodland, understorey scrub	Eroded – wind, human and animal	High disturbance - track grading, minor fencing, and natural erosion
SU3	Slope – moderate to steep slope	Uplifted Sedimentary – shales with volcanic outcropping/ seams	Skeletal red podsols– shattered rock and gravels	Open woodland, understorey scrub	Eroded – wind, human and animal	High disturbance - track grading, minor fencing, and natural erosion
SU4	Crest – steep sloping broad crest down to open depression	Sedimentary – shales	Shallow brown sandy loams on the lower slopes and yellow soloths on mid slopes and crests	Sparse trees, well grassed	Eroded – sheet, human and animal	High disturbance -grazing, clearance, track grading, minor fencing, and natural erosion
SU5	Crest – broad undulating with moderate to steep side slopes	Uplifted Sedimentary – shales with volcanic outcropping/ seams	Shallow brown sandy loams on saddles and brown loams on upper slopes and crests	Open woodland partially cleared for grazing, sparsely grassed	Eroded – sheet, human and animal	High disturbance -grazing, clearance, and natural erosion
SU6	Undulating open depression dissected by ephemeral drainage lines – not permanent water	Volcanic - outcropping granites greywacke and quartz	Skeletal to shallow brown loams	Open woodland partially cleared for grazing, sparsely grassed	Eroded – sheet, human and animal	High disturbance -grazing, clearance, track grading, dams, and natural erosion
SU7	Ridgeline –steep side slopes and saddles	Volcanic - outcropping granites greywacke and quartz	Skeletal to shallow brown loams	Open woodland partially cleared for grazing, sparsely grassed	Eroded – sheet, human and animal	High disturbance -grazing, clearance, track grading, dams, and natural erosion
SU8	Ridgeline – narrow crest with steep side slopes, peaks, and saddles	Uplifted Sedimentary – shales with volcanic outcropping/ seams	skeletal to shallow brown sandy loams on saddles and brown loams on upper slopes and crests	Open woodland partially cleared for grazing, sparsely grassed	Eroded – sheet, human and animal	High disturbance -grazing, clearance, track grading, dams, and natural erosion

Survey Unit	Landform	Geology	Soils	Vegetation	Geomorphology	Disturbance
SU9	Ridgeline –narrow, steep side slopes and saddles	Volcanic - outcropping granites greywacke and quartz	Skeletal to shallow brown loams	Open woodland, understorey scrub	Eroded – wind, human and animal	Moderate disturbance - track grading, minor fencing, and natural erosion
SU10	Crest – broad undulating with moderate to steep side slopes, long flat saddles between hills	Uplifted Sedimentary – shales with volcanic outcropping/ seams	Shallow brown sandy loams on saddles and brown loams on upper slopes and crests	Sparse trees, well grassed	Eroded – sheet, human and animal	High disturbance -grazing, clearance, track grading, minor fencing, and natural erosion
SU11	Ridgeline –steep side slopes and saddles	Volcanic - outcropping granites greywacke and quartz	Skeletal to shallow brown loams	Open woodland partially cleared for grazing, sparsely grassed	Eroded – sheet, human and animal	High disturbance -grazing, clearance, track grading, dams, and natural erosion
SU12	Open depression with gentle slopes, permanent water creek and springs	Uplifted Sedimentary – shales with volcanic outcropping/ seams	Skeletal to shallow brown loams	Sparse trees, well grassed	Eroded – sheet erosion, human and animal	High disturbance -grazing, clearance, track grading, and natural erosion
SU13	Crest – broad undulating with moderate to steep side slopes	Volcanic - outcropping granites, basalt, and quartz common	Skeletal to shallow brown loams	Sparse trees, well grassed	Eroded – sheet erosion, human and animal	High disturbance -grazing, clearance, track grading, and natural erosion
SU14	Ridgeline – narrow crest with steep side slopes, peaks, and saddles	Uplifted Sedimentary – shales with volcanic outcropping/ seams	Skeletal red podsols– shattered rock and gravels	Open woodland, understorey scrub	Eroded – sheet and human	High disturbance - track grading, and natural erosion
SU15	Crest – broad undulating with moderate to steep side slopes, long flat saddles between hills	Uplifted Sedimentary – shales with volcanic outcropping/ seams	Shallow brown sandy loams on saddles and brown loams on upper slopes and crests	Open woodland, understorey scrub	Eroded – sheet and human	Moderate disturbance – tree clearance and natural erosion
SU16	Crest – broad undulating with moderate to steep side slopes, long flat saddles between hills	Uplifted Sedimentary – shales with volcanic outcropping/ seams	Shallow brown sandy loams on saddles and brown loams on upper slopes and crests	Open woodland, understorey scrub	Eroded – sheet and human	Moderate disturbance - track grading, minor fencing, and natural erosion
SU17	Ridgeline –steep side slopes and saddles	Uplifted Sedimentary – shales with volcanic outcropping/ seams	Skeletal to shallow brown loams	Open woodland, understorey scrub	Eroded – sheet erosion, human	High disturbance - track grading, and natural erosion

Survey Unit	Landform	Geology	Soils	Vegetation	Geomorphology	Disturbance
SU18	Ridgeline – narrow crest with steep side slopes, peaks, and saddles	Volcanic - outcropping granites greywacke and quartz	Skeletal to shallow brown loams	Open woodland, understorey scrub	Eroded – sheet erosion, human	High disturbance - track grading, and natural erosion
SU19	Ridgeline – narrow crest with steep side slopes, peaks, and saddles	Volcanic - outcropping granites, basalt, and quartz common	Skeletal to shallow brown loams	Open woodland, understorey scrub	Eroded – sheet erosion, human	High disturbance - track grading, and natural erosion
SU20	Ridgeline – narrow crest with steep side slopes, peaks, and saddles	Uplifted Sedimentary – shales with volcanic outcropping/ seams	Skeletal to shallow brown loams	Open woodland, understorey scrub	Eroded – sheet erosion, human	High disturbance - track grading, and natural erosion
SU21	Crest – broad undulating with moderate to steep side slopes	Volcanic - outcropping granites, basalt, and quartz common	Shallow brown sandy loams on saddles and brown loams on upper slopes and crests	Open woodland, partially cleared understorey scrub	Eroded – sheet erosion, human and animal	High disturbance - clearance, track grading, and natural erosion
SU22	Slope – moderate to steep slope down to creek with permanent water	Uplifted Sedimentary – shales with volcanic outcropping/ seams	Skeletal red podsols– shattered rock and gravels	Open woodland, partially cleared understorey scrub	Eroded – sheet erosion, human	High disturbance - clearance, track grading, and natural erosion
SU23	Ridgeline – narrow crest with steep side slopes, peaks, and saddles	Uplifted Sedimentary – shales with volcanic outcropping	Skeletal to shallow brown loams	Open woodland partially cleared, sparsely grassed	Eroded – sheet erosion, human and animal	High disturbance - clearance, track grading, and natural erosion
SU24	Ridgeline – narrow crest with steep side slopes, peaks, and saddles	Uplifted Sedimentary – shales with volcanic outcropping	Skeletal to shallow brown loams	Open woodland partially cleared, sparsely grassed	Eroded – sheet erosion, human and animal	High disturbance - clearance, track grading, and natural erosion
SU25	Ridgeline – narrow crest with steep side slopes, peaks, and saddles	Uplifted Sedimentary – shales with volcanic outcropping	Skeletal to shallow brown loams	Open woodland partially cleared for grazing, sparsely grassed	Eroded – sheet erosion, human and animal	High disturbance -grazing, clearance, track grading, and natural erosion
SU26	Open depression – flat to gentle undulating	Volcanic - outcropping granites, basalt, and quartz common	Skeletal to shallow brown sandy loams	Sparse trees, well grassed	Eroded – sheet erosion, human and animal	High disturbance -grazing, clearance, track grading, and natural erosion

Survey Unit	Landform	Geology	Soils	Vegetation	Geomorphology	Disturbance
SU27	Open depression gently sloping to steep side slopes	Volcanic - outcropping granites, basalt, and quartz common	Skeletal to shallow brown sandy loams high gravel content	Open woodland partially cleared for grazing, well grassed	Eroded – sheet erosion, human and animal	High disturbance -grazing, clearance, dams, minor fencing, and natural erosion
SU28	Open depression – flat to gentle undulating, dissected by low lying spurs and ephemeral drainage lines	Volcanic - outcropping granites, basalt, and quartz common	Skeletal to shallow brown sandy loams high gravel content	Open woodland, understorey scrub, well grass	Eroded – sheet erosion, human and animal	High disturbance -grazing, clearance, dams, track grading, minor fencing, and natural erosion
SU29	Slope –steep side slope	Uplifted Sedimentary – shales with volcanic outcropping/ seams	Skeletal red podsols– shattered rock and gravels	Open woodland partially cleared	Eroded – sheet erosion, human	High disturbance – track and vehicle usage/ grading, minor fencing, and natural erosion
SU30	Open depression – flat to gentle undulating, dissected by low lying spurs and ephemeral drainage lines	Volcanic - outcropping granites, basalt, and quartz common	Shallow brown sandy loams on saddles and brown loams on upper slopes and crests	Open woodland partially cleared for grazing, sparsely grassed	Eroded – sheet erosion, human and animal	High disturbance -grazing, clearance, dams, track grading, minor fencing, and natural erosion
SU31	Open depression – flat to gentle undulating, dissected by low lying spurs and ephemeral drainage lines	Volcanic - outcropping granites, basalt, and quartz common	Shallow brown sandy loams on saddles and brown loams on upper slopes and crests	Open woodland, understorey scrub, sparse grass	Eroded – wind, human and animal	Moderate disturbance - grazing, dams, track grading, minor fencing, and natural erosion
SU32	Crest – broad undulating with moderate to steep side slopes	Uplifted Sedimentary – shales with volcanic outcropping/ seams	Skeletal to shallow brown sandy loams high gravel content	Open woodland partially cleared for grazing, sparsely grassed	Eroded – wind, human and animal	High disturbance -grazing, clearance, dams, and natural erosion
SU33	Crest – broad undulating with moderate to steep side slopes	Volcanic - outcropping granites, basalt, and quartz common	Shallow brown sandy loams on saddles and brown loams on upper slopes and crests	Open woodland, partially cleared understorey scrub	Eroded – sheet erosion, human and animal	High disturbance - clearance, track grading, and natural erosion
SU34	Open depression – flat to gentle undulating, dissected by low lying spurs and ephemeral drainage lines	Volcanic - outcropping basalt, and quartz common	Shallow brown sandy loams on saddles and brown loams on upper slopes and crests	Open woodland partially cleared for grazing, sparsely grassed	Eroded – sheet erosion, human and animal	High disturbance -grazing, clearance, dams, track grading, minor fencing, and natural erosion

Survey Unit	Landform	Geology	Soils	Vegetation	Geomorphology	Disturbance
SU35	Open depression – flat to gentle undulating, dissected by low lying spurs and ephemeral drainage lines	Volcanic - outcropping basalt, and quartz common	Shallow brown sandy loams on saddles and brown loams on upper slopes and crests	Open woodland partially cleared for grazing, sparsely grassed	Eroded – sheet erosion, human and animal	High disturbance -grazing, clearance, dams, track grading, minor fencing, and natural erosion
SU36	Slope – moderate to steep slope down to Drainage lines	Uplifted Sedimentary – shales with volcanic outcropping/ seams	Skeletal red podsols– shattered rock and gravels	Open woodland, partially cleared understorey scrub	Eroded – sheet erosion, human	High disturbance - clearance, track grading, and natural erosion

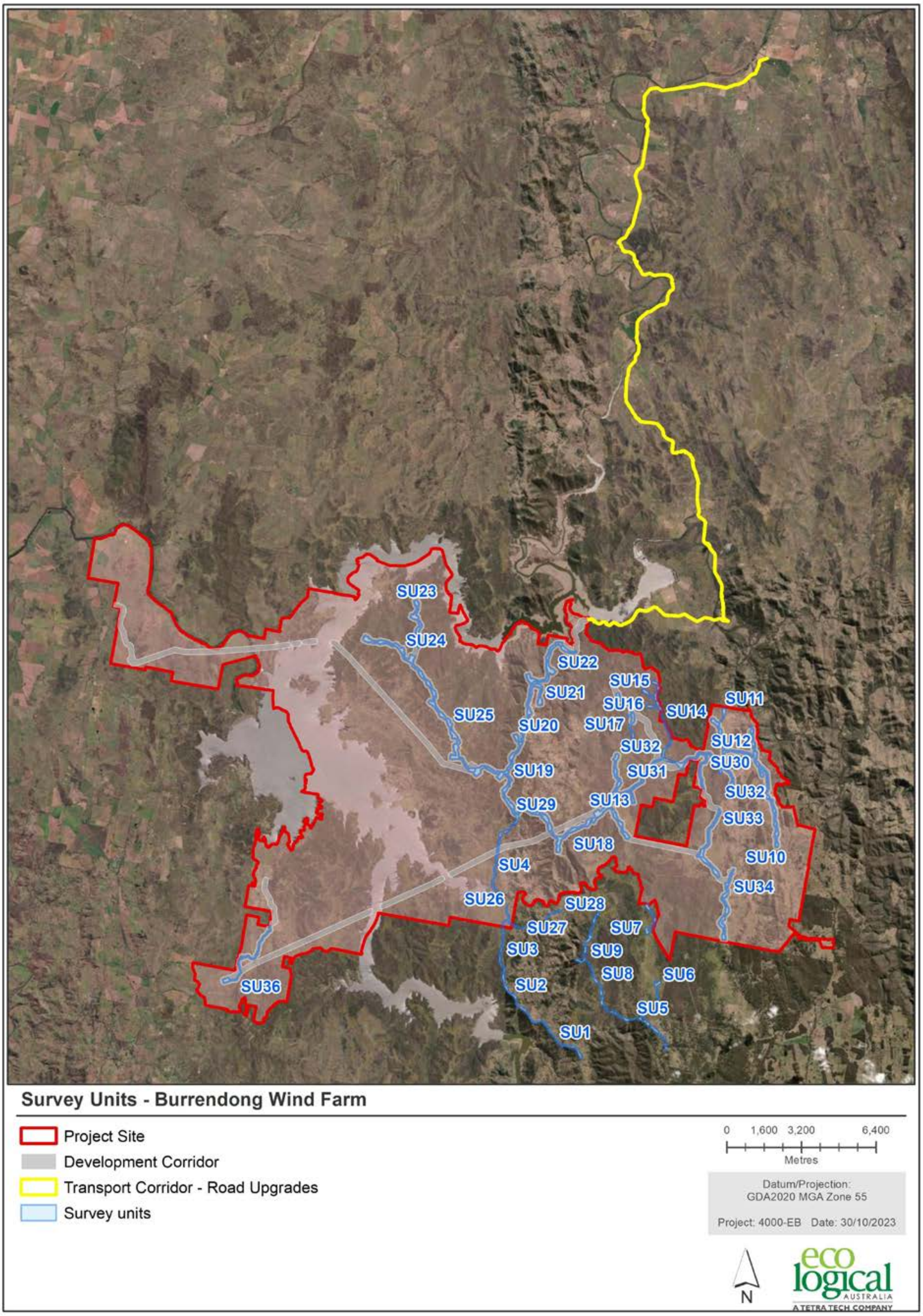


Figure 6-37: Survey units and Aboriginal artefact locations within the Project Site

In total, the field survey sampled a Development Corridor of approximately 1,100 ha. A large portion of the proposed Development Corridor covers steep to moderately sloping landforms that is very unlikely to contain Aboriginal objects. Most WTG sites were surveyed, while a few were missed either due to inaccessibility or dense grass cover. Overhead transmission line corridors were not surveyed due to time constraints.

During the field survey, 102 Aboriginal objects were identified, with 37 of these objects identified within the Development Footprint. Stone artefacts were the most abundant material evidence of Aboriginal occupation/utilisation of the Project Site.

6.8.1.4. Consultation

As part of the ACHA process, Aboriginal consultation has been undertaken and is ongoing. Consultation with Registered Aboriginal Parties (RAPs) has been conducted in line with Heritage NSW *Aboriginal Cultural Heritage consultation requirements for proponents* 2010 (DECCW, 2010). It allows Aboriginal stakeholders to register and fully engage in all aspects relating to cultural heritage regarding the Project. The consultation process occurs across four (4) stages:

- Stage 1 - Notification of Project Proposal and registration of interest
- Stage 2 - Presentation of information about Project
- Stage 3 - Gathering information about Cultural significance
- Stage 4 - Review of draft assessment

STAGE ONE

On behalf of the Proponent, ELA undertook a registration process for Aboriginal people with knowledge of the area. This included writing to the following organisations seeking Aboriginal people who may hold cultural knowledge relevant to determining the significance of Aboriginal objects within the Project Site:

- Heritage NSW, Department of Premier and Cabinet
- Mudgee Local Aboriginal Land Council
- Wellington Local Aboriginal Land Council
- The Registrar, Aboriginal Land Rights Act 1983
- National Native Title Tribunal
- Native Title Services Corporation Limited (NTSCOPR Limited)
- Mid-Western Regional Council
- Dubbo Regional Council
- Local Land Services, Central West
- Dubbo Daily Liberal (local newspaper advertisement)

Following the registration process, a total of seven (7) registrants expressed interest and became the RAPs for the Project. The registered parties include:

- Mudgee LALC
- Corroboree Aboriginal Corporation
- Gunjeewong
- Murong Gialinga Aboriginal & Torres Strait Islander Corporation

- Wellington Valley Wiradjuri Aboriginal Corporation (WVWAC)
- Binjang Wellington Wiradjuri Heritage Survey
- Wellington Aboriginal Action Part

STAGE TWO

Following the registration of the RAPs, they were provided with Project information and the survey sampling strategy and ACHA methodology on 3 May 2021. No written responses were received from the RAPs. During the field survey, it was made known that the groups who participated considered the sampling survey inadequate and sought to undertake a full coverage pedestrian survey.

STAGE THREE

The survey of the study area was undertaken by ELA archaeologists and representatives of the RAPs. The survey was conducted over a four (4) week period between 3-14 May 2021, 21-25 June 2021 and 18-22 October 2021. Representatives of four (4) RAPs participated in the surveys undertaken.

STAGE FOUR

A copy of the draft ACHA was provided to RAPs for a minimum 28-day review and comment period, which closed on 28 January 2022. An extension was provided until 11 February 2022. ELA received responses from two of the seven RAP groups, as shown in Table 6-65 below.

It is noted that an additional archaeological survey was undertaken by ELA archaeologists and representatives of the RAPs conducted over a week from 13-17 February 2023. A copy of the updated ACHA was again provided to RAPs for a minimum of 28 days, with the review and comment period closing 12 May 2023 and an extension provided until 19 May 2023. One response was received.

Table 6-65: Aboriginal stakeholder responses to draft ACHA

Aboriginal Organisation	Draft ACHA Response
	Response period from 11 February, 2022
Wellington Valley Wiradjuri Aboriginal Corporation	WVWAC have through consultation with other Traditional Elders and Traditional Community with cultural knowledge have the following comments and recommendations: • Not all access tracks to be used or impacted for the Project were surveyed by pedestrian assessment, most were driven over and only stopped at areas where turbines were planned, this needs to be rectified and all tracks MUST be surveyed by walking to identify cultural sites that will be impacted. • It is also noted that the few tracks that were surveyed on foot by RAPs, in most cases Cultural Heritage Sites were identified. • WVWAC notes that the access route into the Project Site has not been surveyed, this being via Twelve Mile Road and/or Yarrabin Road. • This area has significant “Song Lines” through it and spiritually the impact that this Project will cause is High. • There are two burial locations known to WVWAC Elders and Members close to this Project location, both at this stage are outside any Project related impacts, however if this were to change with access tracks in the Gundowda Road area, in depth discussions with WVWAC Elders and Members will be required. There is also a third burial site known, however this is further outside the Project Site and may only be impacted if powerline easements are in the vicinity. • Table 11 pp. 52-55 (now Table 12 pp. 53-56).

Aboriginal Organisation	Draft ACHA Response
	2. Relating to the column Significance: Most sites were given the Significance classification as Low, culturally WVWAC, Elders and our members do not agree with this as Culturally ALL of our ancestral sites are Highly Significant, and the more sites destroyed through development mean the greater the significance to our people for the sites that do remain. 3. Mitigation Measures – for sites: BWF AS10, BWF AS11, BWF IF2-RG, BWF IF5, BWF AS14, BWF AS17 and BWF AS38 – Avoid and Redesign project around these Significant Cultural Sites. 4. If sites identified above are impacted WVWAC and other Traditional Owners groups must be negotiated with to achieve an agreed outcome, alternatively WVWAC and other Traditional Owners groups will seek to have this project not approved by the Department of Planning. Mitigation Measures – for remaining sites: These cultural sites must be salvaged by surface collection and where appropriate sub surface, where deposits exist.
Murong Gialinga Aboriginal and Torres Strait Island Corporation	Murong Gialinga have a few concerns they are as follows: We are very concerned that not every access track to be used/ impacted was surveyed by foot they were driven over and only stopped in areas where turbines were planned. These areas need to be surveyed by raps walking over the areas as Aboriginal objects/ sites may be identified as they could be impacted on., most of the areas that were surveyed by foot by the raps identified sites. Murong Gialinga feels it's insulting when most of the sites were given a low significant, to our Wiradjuri people all sites and Aboriginal objects are of high significant as our ancestors made and used them. Mitigation Measures around these sites as follows BWF AS10, BWF AS11, BWF IF2-RG, BWF IF15, BWF AS14, BWF AS 17, BWF AS38 should be avoided and redesigning at all costs around these significant sites. If any of these sites are impacted all Registered Aboriginal Stakeholders must be notified and a meeting, take place to achieve an agreed outcome. Mitigation Measures for remaining sites to be salvaged by a surface collection and where appropriate sub surface where deposits exist.
	Response period from 19 May, 2023
Wellington Valley Wiradjuri Aboriginal Corporation	Wellington Valley Wiradjuri Aboriginal Corporation (WVWAC) would like to thank you for your invitation to provide a response for this Aboriginal Cultural Heritage issue relevant to obligations to protect our Heritage within our Traditional Lands. Wellington Valley Wiradjuri represent traditional families with identified apical ancestry pre-European occupation with our known Traditional Lands. We know our culture, country and continue with our association with our traditional lands (Ngurangbang). WVWAC object to any other non-traditional aboriginal organizations or people taking part in site surveys, consultation and assessments within our defined Traditional Lands. These non-traditional people and groups are outsiders under Traditional Lore and have no right to advise on or to be present during consultation or site visits as they do not possess the specific traditional knowledge in relation to these lands or sites. These participants may be indigenous and may live locally within the region however, this still does not give them the right to disregard Traditional Lore and values. Wellington Valley Wiradjuri Aboriginal Corporation (WVWAC) have through consultation with other Traditional Elders and Traditional Community with cultural knowledge have the following comments and or recommendations: • Not all internal access tracks to be used or impacted for the project were surveyed by pedestrian assessment, most were driven over and only stopped at areas where turbines were planned, this regardless of existing tracks or not should be surveyed by walking to identify any remaining cultural sites that will

Aboriginal Organisation	Draft ACHA Response
	be impacted. It is also noted that the few Tracks that were surveyed on foot by RAP's, in most cases Cultural Heritage Sites were identified. • This project area has significant "Song lines" through it and aesthetically and spiritually the impact that this project will cause is High. • There are two burial locations known to WVWAC Elders and Members close to this project location, both at this stage are outside of any project related impacts, however if this were to change, in depth negotiations with WVWAC Elders and Members will be required. o Table 14 pp. 57-60 Relating to the column Significance: Most sites were given the Significance classification as Low, culturally WVWAC, Elders and our members do not agree with this as Culturally ALL of our ancestral sites are Highly Significant, and the more sites destroyed through development mean the greater the significance to our people for the sites that do remain. o Mitigation Measures – for six (6) sites: BWF AS10, AS11, AS14, AS38, AS86, AS88 and IF5 – Avoid and Redesign project around these Significant Cultural Sites. o If sites identified above are impacted WVWAC and other Traditional Owners groups must be negotiated with to achieve a mutually agreed outcome and management plan o As for the remaining sites: These are listed as having "Unmitigated impacts" and as cultural sites must be salvaged by surface collection and where appropriate sub-surface, where deposits exist. o Non-salvage of impacted sites is unacceptable. All Cultural Material collected through surface collection or sub-surface investigations is to be returned to site and buried in areas close to where the materials originated from the project area. This is to ensure no singular RAP group obtains this material and also ensures that the material is retained within the project area. Due to the size and scope of the project, this will require potentially up to ten or more locations and must be in areas where this or any other future development or property owner activity will not disturb the re-burial location.

6.8.2. Potential Impacts

The *Australia ICOMOS Burra Charter 1999* provides guidance for the assessment, conservation, and management of places of cultural significance. Cultural significance is defined in the Burra Charter as 'a concept which helps in estimating the value of places'. The places that are likely to be of significance are those which help an understanding of the past or enrich the present, and which will be of value to future generations" (ICOMOS Burra Charter 1988). The Burra Charter provides a definition of cultural significance as "aesthetic, historic, scientific, social or spiritual value for past, present or future generations". Aboriginal cultural heritage sites can be assessed through the application of these five principal values.

- Social or cultural value (assessed only by Aboriginal people)
- Historical value
- Scientific/archaeological value (assessed mostly by archaeologists/heritage consultants)
- Aesthetic value
- Spiritual value

6.8.2.1. Social or Cultural Significance

Aboriginal cultural values can only be determined through consultation with the Aboriginal community. All Aboriginal sites are considered to have cultural significance to the Aboriginal community as they provide physical evidence of past Aboriginal use and occupation of the area. Aboriginal cultural significance may include social, spiritual, historic, and archaeological values, and is determined by the Aboriginal community.

The Macquarie River and its higher order tributaries were identified to be of high cultural and archaeological potential because they are a permanent source of water and a rich biodiverse focal point in the surrounding landscape and are likely to have sustained greater levels of occupation. Artefact density along Little Oakey Creek was found to be high and artefact complexity was greater than on other landforms. This area will mostly be avoided by the Project; however, the revised Development Corridor will dissect this area to allow access to the southern arms of the Project. The revised Development Corridor will avoid the highest density Aboriginal sites.

The ridgeline locations of the proposed WTGs have cultural significance providing corridors for movement through the landscape, for hunting and gathering activities and as vantage viewpoints of the surrounding landscape. Mature grass trees were identified within the Development Corridor, these plants are of high cultural value as a resource. Culturally sensitive areas have been identified during the field survey. These areas are of high cultural value and are located outside the Development Corridor. Murong Gialinga and WVWAC have, through consultation with their community, identified all Aboriginal objects and all sites to be of high cultural significance to the Wiradjuri people.

6.8.2.2. Spiritual Significance

The Burrendong area has been identified by the WVWAC elders as having significant "Song lines" through it and spiritually the impact that this project will cause is High. The song lines have been not specifically linked to the Project Site or Development Corridor, but it is considered that the Project will impact on the spirituality of the area for the Wiradjuri Culture.

6.8.2.3. Aesthetic Significance

Aesthetic significance is often closely linked to social and cultural significance. Generally aesthetic significance is considered to mean the visual beauty of a place. Examples of archaeological sites that may have high aesthetic values include rock art sites or sites located in visually pleasing environments (NSW NPWS 1997). The Project Site and surrounding region have been impacted by current and previous historical land use, however there is a spectacular undisturbed view of the surrounding landscape from the top of the ridgelines and crest. This view is very aesthetically like what it would have been prior to historical disturbance. These vantage points still provide cultural views of significant landforms and pathways relevant to the cultural values of the Aboriginal community.

6.8.2.4. Historic Significance

No historic associations with 'place' were identified during the background research and field survey specific to the Development Corridor. There are historical Aboriginal records of utilisation of the Macquarie River and of conflicts between the local families and landowners. Aboriginal historical burials have been recorded outside the Development Corridor. These Aboriginal burials are of high significance to the Aboriginal community and the surviving descendants.

6.8.2.5. Scientific Significance

As with cultural, historic, and aesthetic significance; scientific significance can be difficult to establish. Certain criteria must therefore be addressed to assess the scientific significance of archaeological sites. Scientific significance contains four subsets: research potential, representativeness, rarity, and educational potential. These are outlined below:

- ***Research Potential***: is the ability of a site to contribute to our understanding of Aboriginal occupation locally and on a regional scale. The potential for the site to build a chronology, the level of disturbance within a site, and the relationship between the site and other sites in the archaeological landscape are factors which are considered when determining the research potential of a site.
- ***Representativeness***: is defined as the level of how well or how accurately something reflects upon a sample. The objective of this criterion is to determine if the class of site being assessed should be conserved to ensure that a representative sample of the archaeological record be retained. The conservation objective which underwrites the 'representativeness' criteria is that such a sample should be conserved (NSW NPWS 1997).
- ***Rarity***: This criterion is like that of representativeness, it is defined as something rare, unusual, or uncommon. If a site is uncommon or rare it will fulfil the criterion of representativeness. The criterion of rarity may be assessed at a range of levels including local, regional, state, national and global (NSW NPWS 1997).
- ***Educational Potential***: This criterion relates to the ability of the cultural heritage item or place to inform and/or educate people about one or other aspects of the past. It incorporates notions of intactness, relevance, interpretative value, and accessibility. Where archaeologists or others carrying out cultural heritage assessments are promoting/advocating the educational value of a cultural heritage item or place it is imperative that public input and support for this value is achieved and sought. Without public input and support the educative value of the items/places is likely to not ever be fully realised (NSW NPWS 1997).

The Aboriginal cultural value of the landscape in general, as well as the Aboriginal objects it contains, is considerably higher than the scientific value. Both the landscape and the objects which are encompassed within it are material testament to the lives of people's ancestors and the focus of their current identity, concerns, and aspirations. Therefore, the proposal would have an impact on the cultural significance which attaches to the area.

Low scientific significance has been attributed to all very low to low density stone artefact sites where site integrity was low as being located on either a disturbed or eroded landscape or having low subsurface archaeological potential. These sites are generally isolated artefact find spots or artefact scatters where within a disturbed/eroded landscape where further investigations of the area would not contribute to our understanding of Aboriginal landscape use in the area. Based on the intactness, representativeness, and research potential, these sites are determined to have low scientific significance.

Moderate to high scientific significance has been attributed to all surface artefacts located on a landscape exhibiting moderate to high density and has potential to contain a subsurface archaeological deposit. These sites generally consist of artefact scatters on an undisturbed landscape. Subsequently, moderate to high scientific significance is attributed to sites where further investigations of the area would contribute to our understanding of the Aboriginal landscape use of the area. Based on the intactness, representativeness, and research potential, these sites are determined to have moderate to high scientific significance. The assessed impacts of the Project to Aboriginal sites identified within the Project Site are shown in Table 6-66.

Table 6-66: Impact assessment for Aboriginal sites within the Development Corridor

Aboriginal Site	Overall Significance	Potential Impact	Type of Harm	Degree of Harm	Consequence of Harm
BWF IF2-RG	High	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF IF3	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF IF4	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS13	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS14	High	Turbine Pad Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF SQ2	Low	Turbine Pad Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS21	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS22	Low	Turbine Pad Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS25	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS27	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF IF6	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF IF7	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF IF8	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF IF9	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF IF10	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS30	Low	Land clearance associated turbine infrastructure. Compounds	Direct	Total	Total loss of value

Aboriginal Site	Overall Significance	Potential Impact	Type of Harm	Degree of Harm	Consequence of Harm
BWF AS32	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS33	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS34	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS35	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS45	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS46	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS47	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS52	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS53	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS54	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS55	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS59	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS80	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF AS81	Low	Access tracks/ land clearance, associated turbine infrastructure	Direct	Total	Total loss of value
BWF IF 12	Low	Access tracks/ land clearance for switchyard	Direct	Total	Total loss of value
BWF AS86	Moderate	Access tracks/ land clearance for switchyard	Direct	Total	Total loss of value
BWF AS87	Low	Access tracks/ land clearance for switchyard	Direct	Total	Total loss of value
BWF AS88	Moderate	Access tracks/ land clearance for switchyard	Direct	Total	Total loss of value
BWF AS89	Low	Access tracks/ land clearance for switchyard	Direct	Total	Total loss of value

FURTHER INVESTIGATION

The field survey has been focused on recording lithic material present on visible ground surfaces. Further archaeological investigation would entail subsurface excavation undertaken as test pits for the purposes of identifying the presence of artefact bearing soil deposits and their nature, extent, integrity, and significance.

Two (2) Aboriginal sites (*BWF AS38* and *BWF IF 5*) have been identified in the Project Site and warrant further archaeological investigation to understand the nature and extent of the Aboriginal sites. The open depressions along Little Oakey Creek have identified culturally significant complex sites. This area can be avoided from impact, and it is believed the current Development Corridor will be the least impactful on Aboriginal heritage. However, as a mitigation, test excavation will provide further information on the nature, extent, and context of the Aboriginal sites if they cannot be avoided.

MITIGATED IMPACTS

Mitigated impacts usually take the form of partial impacts only (i.e., conservation of part of an artefact locale or Survey Unit) and/or salvage in the form of further research and archaeological analysis prior to impacts. Such a management strategy is generally appropriate when Aboriginal objects are assessed to be of moderate or high significance to the scientific and/or Aboriginal community and when avoidance of impacts and hence full conservation is not feasible. Salvage can include the surface collection or subsurface excavation of Aboriginal objects and subsequent research and analysis.

Aboriginal object locales in exposed areas should be subject to surface collection and movement outside the Development Corridor. It would also be culturally appropriate to salvage artefacts from certain sites. Accordingly, it is appropriate to implement practical measures that may be taken to protect and conserve Aboriginal objects in the Project Site

Areas of the Development Corridor that have not been subject to archaeological survey should be inspected prior to development impacts to record Aboriginal objects and register the information with AHIMS. If sites of moderate to high significance are identified, then further mitigations may be required.

UNMITIGATED IMPACTS

Unmitigated impact to Aboriginal objects can be given consideration when they are assessed to be of low archaeological and cultural significance, and otherwise in situations where conservation or limiting the extent of impacts is simply not feasible. All sites have had some level of mitigations implemented. Archaeological field survey has recorded information on existing Aboriginal objects within the Development Corridor for low significance sites this is adequate mitigations.

A detailed list of recommended mitigation and management measures for the sites will be outlined Table 6-67.

Table 6-67: Mitigation Measures for Aboriginal sites within the Development Corridor

Aboriginal Site	Overall Significance	Potential impacts	Mitigation measures
BWF IF3	Low	Access tracks/ land clearance, associated turbine infrastructure	Register with AHIMS
BWF IF4	Low	Access tracks/ land clearance, associated turbine infrastructure	Register with AHIMS
BWF AS25	Low	Access tracks/ land clearance, associated turbine infrastructure	If can't be avoided, then surface collection and reburial Register with AHIMS

Aboriginal Site	Overall Significance	Potential impacts	Mitigation measures
BWF SQ2	Low	Turbine Pad Access tracks/ land clearance, associated turbine infrastructure	Register with AHIMS
BWF IF6	Low	Access tracks/ land clearance, associated turbine infrastructure	Register with AHIMS
BWF IF7	Low	Access tracks/ land clearance, associated turbine infrastructure	Register with AHIMS
BWF AS21	Low	Access tracks/ land clearance, associated turbine infrastructure	If can't be avoided, then surface collection and reburial Register with AHIMS
BWF AS22	Low	Turbine Pad Access tracks/ land clearance, associated turbine infrastructure	If can't be avoided, then surface collection and reburial Register with AHIMS
BWF AS27	Low	Turbine Pad Access tracks/ land clearance, associated turbine infrastructure	Register with AHIMS
BWF AS30	Low	Access tracks/ land clearance associated turbine infrastructure. Compounds	Register with AHIMS
BWF IF8	Low	Access tracks/ land clearance, associated turbine infrastructure	Register with AHIMS
BWF AS32	Low	Access tracks/ land clearance, associated turbine infrastructure	Register with AHIMS
BWF IF9	Low	Access tracks/ land clearance, associated turbine infrastructure	Register with AHIMS
BWF IF10	Low	Access tracks/ land clearance, associated turbine infrastructure	Register with AHIMS
BWF AS33	Low	Access tracks/ land clearance, associated turbine infrastructure	Register with AHIMS
BWF AS34	Low	Access tracks/ land clearance, associated turbine infrastructure	Register with AHIMS
BWF AS35	Low	Access tracks/ land clearance, associated turbine infrastructure	Collection and movement Register with AHIMS
BWF AS45	Low	Access tracks/ land clearance, associated turbine infrastructure	If can't be avoided, then surface collection and reburial Register with AHIMS
BWF AS46	Low	Access tracks/ land clearance, associated turbine infrastructure	If can't be avoided, then surface collection and reburial Register with AHIMS
BWF AS47	Low	Access tracks/ land clearance, associated turbine infrastructure	If can't be avoided, then surface collection and reburial Register with AHIMS

Aboriginal Site	Overall Significance	Potential impacts	Mitigation measures
BWF AS52	Low	Access tracks/ land clearance, associated turbine infrastructure	If can't be avoided, then surface collection and reburial Register with AHIMS
BWF AS53	Low	Access tracks/ land clearance, associated turbine infrastructure	If can't be avoided, then surface collection and reburial Register with AHIMS
BWF AS54	Low	Access tracks/ land clearance, associated turbine infrastructure	If can't be avoided, then surface collection and reburial Register with AHIMS
BWF AS55	Low	Access tracks/ land clearance, associated turbine infrastructure	Register with AHIMS
BWF AS59	Low	Access tracks/ land clearance, associated turbine infrastructure	Register with AHIMS
BWF AS13	Low	Access tracks/ land clearance, associated turbine infrastructure	Register with AHIMS
BWF AS80	Low	Access tracks/ land clearance, associated turbine infrastructure	Register with AHIMS
BWF AS81	Low	Access tracks/ land clearance, associated turbine infrastructure	Register with AHIMS
BWF IF 12	Low	Access tracks/ land clearance for switchyard	Register with AHIMS
BWF AS87	Low	Access tracks/ land clearance for switchyard	Register with AHIMS
BWF AS89	Low	Access tracks/ land clearance for switchyard	Register with AHIMS
BWF AS86	Moderate	Access tracks/ land clearance for switchyard	If can't be avoided, then surface collection and reburial.
BWF AS88	Moderate	Access tracks/ land clearance for switchyard	If can't be avoided, then surface collection and reburial.
BWF IF2-RG	High	Access tracks/ land clearance, associated turbine infrastructure	Avoidance Redesign the Access track to avoid site
BWF AS14	High	Turbine Pad Access tracks/ land clearance, associated turbine infrastructure	Avoidance If can't be avoided, then surface collection and reburial

6.8.2.6. Field Survey Impacts

At the time of the field survey ground visibility and exposure was relatively low within the broader Project Site. Due to recent rains visibility was obscured by dense grass and weed ground cover, and along ridge lines and in the high country there had been very little disturbance or land clearance.

The proposed access tracks to the WTGs will follow existing vehicle tracks that cover most of the Development Corridor. The field survey focused on the most likely impact areas for access and the likely footprint of each WTG. The ground visibility and exposure within the Development Footprint was quite high across the surveyed area which meant there was a relatively high effective coverage. The geomorphological context was found to be eroded in most areas, even along drainage lines, creek lines and open depressions. Exposed soil profiles were shallow and exposed bedrock was visible across much of the Development Corridor. Ground surfaces with high visibility usually presented a relatively high exposure rate as the soils across the Development Corridor are skeletal with frequent rock outcropping. The archaeological potential of the Development Corridor is very unlikely with discrete sites being identified as containing potential archaeological deposit.

Most Aboriginal objects sites were assessed to be very low-density artefact distributions and were distributed across ridge lines and broad crests. However, a few moderate to high density sites have been identified, of which all were located adjacent to permanent water sources in open depressions and on flat raised landforms. One high density site was identified on a ridgeline located directly next to a quartz source and near a basalt stone quarry. It is noted that while every effort was made to record ground exposure and archaeological visibility accurately, these estimations are inherently problematic and, accordingly, comparisons of artefact density between locales may not be sensible.

Generally, the Aboriginal object sites are representative of the artefact distribution and density within the entire Survey Unit in which they are situated. That is, they do not appear to be representative of discrete artefact locations but instead, they form part of the very low density 'background scatter' which is present across the landscape. Focus was identified near areas of permanent water sources or resource gathering zones.

6.8.3. Mitigation Measures

Table 6-68 summarises the proposed measures to mitigate potential Aboriginal cultural heritage impacts.

Table 6-68: Mitigation Measures for Aboriginal Cultural Heritage Impacts

Environmental Impact	Mitigation Measure	Reference Code
General	Prepare a Cultural Heritage Management Plan (CHMP) to the satisfaction of the Secretary. The CHMP should document the procedures to be followed and must: • Be developed in consultation with an archaeologist, the RAPs and Heritage NSW. • Provide guidance as to allowable impacts and to ensure the effectiveness and reliability of mitigation and management strategies which may include salvage excavation, if required. • Provide information on management of Aboriginal sites outside the Development Corridor. • Include a description of the measures that would be implemented for: o Protecting relevant Aboriginal heritage items identified in the ACHA and any items located outside the Project clearance area. o A contingency plan and reporting procedure if: - Aboriginal heritage items outside the approved clearance area are damaged. - Previously identified Aboriginal heritage items are found; or - Aboriginal skeletal material is discovered. o Ensuring workers on-site receive suitable heritage inductions in line with the NPW Act prior to carrying out any development on-site, and that records are kept of these inductions. • Include an unexpected finds protocol in which: o All contractors are briefed with regards to the protection of Aboriginal heritage objects under the NPW Act and the penalties for damage when undertaking works on site. o Should an unexpected Aboriginal object be identified during construction, work in the immediate vicinity of the find is to stop and the area fenced. o The Proponent should be notified. o RAPs and an archaeologist should be engaged to determine the significance of the find, and if required, determine the notification, further consultation and approvals required. o Works at the site of an unexpected find should not recommence until DPE/Heritage NSW has provided written approval. o Human remains are discovered, work ceases immediately, and the NSW Police are contacted. If the remains are suspected to be Aboriginal, consider contacting DPE to assist in determining appropriate management. The Proponent must implement the approved CHMP during construction and operational phases of the Project.	AH001
Aboriginal Heritage Items	All Aboriginal sites within the Development Corridor and identified through field survey are to be registered with AHIMS.	AH002

Environmental Impact	Mitigation Measure	Reference Code
	Avoidance and conservation should always be the preferred option for cultural management. If avoidance cannot be achieved, then mitigation measures outlined in Table 6-67 should be implemented.	AH003
	Where possible, maintain ground disturbances to a minimum and done discreetly.	AH004
	When conservation is adopted as a management option it may be necessary to implement various strategies to ensure Aboriginal object locales are not inadvertently destroyed or disturbed during construction works or within the context of the life of the development project. Such procedures are essential when development works are to proceed within proximity to identified sites. All Aboriginal sites located outside the development footprint will be avoided and a construction management plan should be implemented, and a Heritage induction be provided to construction staff and contractors. Impacts to specifically identified Aboriginal sites, including: • *BWF IF2 - Resource* is located within the development footprint of high cultural significance and should be avoided. Access tracks and infrastructure should be redesigned to conserve the cultural resource. Fencing or barriers should be erected to protect site. • *BWF IF5* – a potential campsite and due to the landform, there is potential for intact deposits and the site should be avoided. This site is not located within the current development footprint. If it was to be impacted, then further subsurface investigations will be required. • BWF AS38 – a moderate density artefacts scatter and due to the raised landform adjacent to permanent water there is potential for intact deposits. This site is not within the current development footprint and should be avoided. If it was to be impacted, then further subsurface investigations will be required. Surface collection would also be required to mitigate impacts. • BWF AS10, BWF AS11, BWF AS14, BWF AS86 and BWF AS88 – sites should be avoided due to the moderate significance of the sites. BWF AS10 and BWF AS11 will no longer be impacted under the current development footprint. If it was to be impacted, then surface collection would be required to mitigate impacts. • BWF AS14, BWF AS86 and BWF AS88 – these sites will be impacted, and surface collection will be required to mitigate impacts.	AH005
	Undertake additional archaeological assessment in any areas which are proposed for impacts that have not been surveyed during the ACHA process following final Project design.	AH006

6.9 Historic Heritage

A Historic Heritage Assessment has been prepared by ELA within this EIS. The assessment has been undertaken in accordance with the requirements of the SEARs, which include:

- *Assess the impact to historic heritage having regard to the NSW Heritage Manual*

Assessment Overview

A search of the Australian Heritage Database revealed that there are no listed heritage items within the Project Site. There are 20 heritage items within 5 km of the Project Site that are listed under either the Wellington or Mid-Western LEP. Two (2) items are located immediately adjacent to the Project Site (external transport route), however there are no sites listed within the Project Site.

Field survey across the Project Site was undertaken where two derelict cottages were identified in the western part of the Project Site. All these built elements are simple utilitarian structures necessary for a functioning farm. They are all in poor condition and are not assessed as significant. Apart from fencing, the remainder of the property has no additional evidence of historical use.

There are no heritage items in the Project Site and the potential for historical archaeological features or deposits is low. The property has functioned in a pastoral capacity since the 19th century and development activity on the property is minimal. The proposed roads, WTGs and electricity infrastructure will not be located near these structures and there will be no impacts because of the Project.

While there are several heritage items within the surrounding area, they are at a distance to the Project Site or will be located immediately adjacent to areas where minor works will be undertaken. Furthermore, no items of local historic significance have been identified within the Project Site or Development Corridor.

Mitigation measures have been proposed to mitigate potential impacts of the Project in Section 6.9.3.

6.9.1. Existing Environment

6.9.1.1. Historical Context

The Project Site is within both the Dubbo Regional Council and Mid-Western Regional Council LGAs and covers the Parish of Wear, Canning, and Kerr in the County of Wellington.

The land between Mudgee and the Macquarie River to the west was first explored by European settlers in the 1820s when James Blackman headed north to the Mudgee region from Lithgow and crossed the Cudgegong River. William Lawson, a member of the first European party to cross the Blue Mountains in 1813, followed Blackman's route and found some excellent grazing land. He was immediately followed by George and Henry Cox (sons of William Cox who built the first road over the Blue Mountains) who became the first permanent European settlers on the Cudgegong River.

Large cattle and sheep runs were established across the region, however the population remained low until 1851 when gold was found at nearby Hargraves and later in Hill End. The Project Site is located in parts of the former Mudgee, Wellington, and Macquarie gold fields which operated up until the 1880s and was then sold off in smaller land parcels with some of the descendants still owning properties in the area.

6.9.1.2. Australian Heritage Database

There are no heritage items within the Project Site listed on the Australian Heritage Database.

6.9.1.3. Wellington and Mid-Western Local Environmental Plans

There are 20 heritage items within 5 km of the Project Site that are listed under either the Wellington or Mid-Western LEP (Table 6-69 and Figure 6-38). Two (2) items are located immediately adjacent to the Project Site (external transport route), however there are no sites listed within the Project Site.

Table 6-69: Local heritage results listed under the Wellington and Mid-Western LEPs

Item No.	LEP/Act	Item Name	Significance
I63	Wellington LEP	St Mary the Virgin Anglican Church	Local
I64	Wellington LEP	Burrendong Arboretum	Local
I77	Wellington LEP	Railway Gatekeeper's Cottage	Local
I78	Wellington LEP	Yee Lee's Store (former)	Local
I79	Wellington LEP	Crick's Store	Local
I80	Wellington LEP	Boehme's Hall	Local
I81	Wellington LEP	St John the Baptist Catholic Church	Local
I82	Wellington LEP	Stuart Town Railway Station Group	State
I83	Wellington LEP	Post office (former Railway Hotel)	Local
I84	Wellington LEP	Stuart Town School of Arts	Local
I85	Wellington LEP	Residence and artist studio (former Stuart Town Bakery)	Local
I86	Wellington LEP	Australia Hotel (former Carrington Hotel)	Local
I87	Wellington LEP	Stuart Town gold mining area and common	Local
I88	Wellington LEP	Stuart Town General Cemetery	Local
I89	Wellington LEP	St Michael and All the Angels Anglican Church and Convict Bell A	Local

Item No.	LEP/Act	Item Name	Significance
I369	Mid-Western LEP	Morrowolga homestead	Local
I421	Mid-Western LEP	Yamble homestead and outbuildings	Local
I979	Mid-Western LEP	Wingvee Homestead and Woolshed and Quartz Roasting Pits	State
I998	Mid-Western LEP	Ben Buckley Homestead and Woolshed	Local
5012226	Heritage Act	Stuart Town Railway Station Group	State

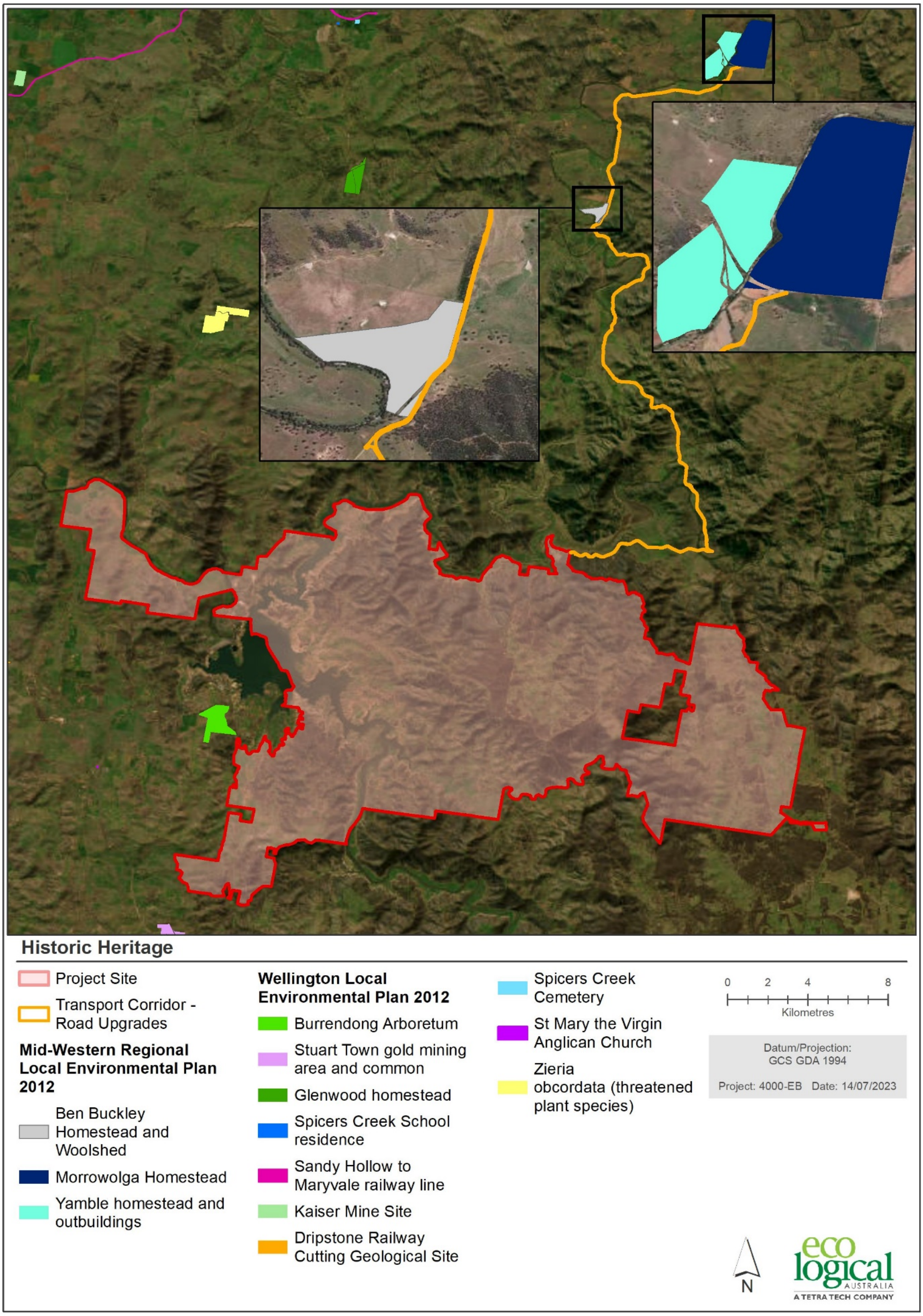


Figure 6-38: Listed heritage items in proximity to the Project Site

Field survey across the Project Site was undertaken by ELA, where two derelict cottages (Figure 6-39 and Figure 6-40) were identified in the western part of the Project Site. These were constructed of multiple materials from different time periods and appear to be accommodation for shearers or farm hands. The exterior comprised sections of timber and iron cladding, a handmade brick fireplace and pise (rammed earth) or wattle and daub walls. Interior ceilings and walls were clad in hessian, timber, pise, Masonite, and sarking, while floors were comprised of lino or timber. The roof and wall frame were composed of untreated saplings, with bark remaining and milled timbers. Bunk beds, fridge, bath, and cupboards are still present and a calendar dating to July 1984 was hanging on the wall.

The buildings were cobbled together (Figure 6-41) with whatever material was available and appear to have undergone alterations and additions over time. A shed with three bays and open on one side was located nearby and all that remains of a fourth structure are the timber stumps it sat on (Figure 6-42). All these built elements are simple utilitarian structures necessary for a functioning farm. They are all in poor condition and are not assessed as significant. Apart from fencing, the remainder of the property has no additional evidence of historical use.

Figure 6-39: Pise and timber cottage

Figure 6-40: Corrugated iron cottage

Figure 6-41: **View of cottages from the rear**

Figure 6-42: Open shed

No other historic heritage items or relics were recorded in the Project Site.

6.9.2. Potential Impacts

There are no heritage items in the Project Site and the potential for historical archaeological features or deposits is low. The property has functioned in a pastoral capacity since the 19th century and development activity on the property is minimal.

The proposed roads, WTGs and electricity infrastructure will not be located near these structures and there will be no impacts because of the Project.

While there are several heritage items within the surrounding area, they are at a distance to the Project Site or will be located immediately adjacent to areas where minor works will be undertaken, i.e., road access improvements or powerline easements. Furthermore, no items of local historic significance have been identified within the Project Site or Development Corridor.

Potential impacts on identified historic heritage items are described in Table 6-70 below.

Table 6-70: Potential impacts on local heritage results (Wellington and Mid-Western LEPs 2012)

Item Name and No.	Curtilage Distance From		Potential Impacts
	Project Site (km)	Development Footprint (km)	
I63: St Mary the Virgin Anglican Church	4.64	6.32	No potential impact
I64: Burrendong Arboretum	0.18	2.37	No potential impact
I77: Railway Gatekeeper's Cottage	3.40	4.60	No potential impact
I78: Yee Lee's Store (former)	3.29	4.50	No potential impact
I79: Crick's Store	3.00	4.23	No potential impact
I80: Boehme's Hall	3.06	4.30	No potential impact
I81: St John the Baptist Catholic Church	2.78	4.01	No potential impact
I82: Stuart Town Railway Station Group	2.82	4.05	No potential impact
I83: Post office (former Railway Hotel)	3.02	4.25	No potential impact
I84: Stuart Town School of Arts	3.16	4.38	No potential impact
I85: Residence and artist studio (former Stuart Town Bakery)	3.23	4.46	No potential impact
I86: Australia Hotel (former Carrington Hotel)	3.09	4.31	No potential impact
I87: Stuart Town gold mining area and common	1.84	3.07	No potential impact
I88: Stuart Town General Cemetery	4.02	5.25	No potential impact
I89: St Michael and All the Angels Anglican Church and Convict Bell A	3.07	4.28	No potential impact
I369: Morrowolga homestead	0.00	0.00	Located adjacent to external transport route and considered negligible impact.
I421: Yamble homestead and outbuildings	0.26	0.29	Located adjacent to external transport route and considered negligible impact.
I979: Wingvee Homestead and Woolshed and Quartz Roasting Pits	4.78	5.88	No potential impact

Item Name and No.	Curtilage Distance From		Potential Impacts
	Project Site (km)	Development Footprint (km)	
I998: Ben Buckley Homestead and Woolshed	0.00	0.00	Located adjacent to external transport route and considered negligible impact.
5012226: Stuart Town Railway Station Group	2.81	4.05	No potential impact

6.9.3. Mitigation Measures

Table 6-71 outlines the proposed measures to mitigate potential historic heritage impacts.

Table 6-71: Mitigation Measures for Historic Heritage Impacts

Environmental Impact	Mitigation Measure	Reference Code

Unexpected Finds	Adopt a standard unexpected finds process during works associated with the proposal as a mitigation measure as follows:
	• An 'unexpected heritage find' can be defined as any unanticipated archaeological discovery, that has not been previously assessed or is not covered by an existing approval under the Heritage Act or NPW Act. These discoveries are categorised as either:
	  o Aboriginal objects (archaeological remains i.e.: stone tools)
	  o Historic (non-Aboriginal) heritage items (archaeological remains (i.e.: artefacts) or movable objects)
	  o Human skeletal remains.
	• Should any unexpected historical archaeology be uncovered during any future excavation works, the following procedure must be adhered to:
	  o Stop all work in the immediate area of the item and notify the Project Manager
	  o Establish a 'no-go zone' around the item. Use high visibility fencing, where practical. Inform all site personnel about the no-go zone
	  o No work is to be undertaken within this zone until further investigations are completed
	  o Engage a suitably qualified and experienced Archaeologist to assess the finds
	  o The Heritage Council must be notified if the finds are of local or state significance. Additional approvals will be required before works can recommence on site
	  o If the item is assessed as not a 'relic', a 'heritage item' or an 'Aboriginal object' by the Archaeologist, work can proceed with advice provided in writing.
		HH001

6.10 Soils, Land Use and Agricultural Land

An Agricultural Impact Assessment has been prepared by Tucker Environmental (2023; Appendix P), as well as an Air Quality Assessment conducted by Benbow Environmental (2023; Appendix P). The assessments have been undertaken in accordance with the requirements of the SEARs, which include:

- *Provide a detailed justification of the suitability of the site and that the site can accommodate the proposed development having regard to its potential environmental impacts, permissibility, strategic context, and existing site constraints;*
- *Assess the potential impacts of the development on existing land uses on the site and adjacent land, including:*
  - *Consider direct and/or indirect impacts to WaterNSW lands and infrastructure;*
  - *Consider agricultural land, biosecurity, any Travelling Stock Routes, flood prone land, Crown lands, public recreation, mining, quarries, mineral or petroleum rights;*

  - *Undertake soil survey to determine the soil characteristics and consider the potential for erosion and sedimentation to occur, and consideration of salinity in this area; and*
  - *Assess cumulative impact of nearby developments;*

- *Assess the compatibility of the development with existing land uses, during construction, operation and after decommissioning, including:*
- *Consider the zoning provisions applying to the land, including subdivision (if required);*
- *Complete a Land Use Conflict Risk Assessment in accordance with the Department of Industry's Land Use Conflict Risk Assessment Guide; and*
- *Assess the impact on agricultural resources and agricultural production on the site and region.*

Assessment Overview

SOILS AND EROSION

Erosion and sedimentation impacts are likely to occur during the construction phase of the Project due to vegetation clearing and excavation required to construct roads, WTG foundations and associated Project infrastructure. Erosion potential will increase when groundcover is removed however, this will be appropriately mitigated through the implementation of an Erosion and Sediment Control Plan.

NATURALLY OCCURING ASBESTOS

The Project Site is in the vicinity of geological units comprising serpentine minerals that have the potential for Naturally Occurring Asbestos (NOA) to be present. Geotechnical investigations undertaken at the detailed design stage will determine if NOA is present and appropriate measures will be implemented, if required.

AIR QUALITY

Impacts from the Project resulting from dust and other airborne emissions would occur primarily throughout the construction phase, with operational air pollution emissions being negligible. Due to most of the winds being medium to strong winds during the daytime (when most earthworks occur), any emitted pollutants would likely be dispersed quickly with low impacts on the surrounding area.

AGRICULTURAL LAND USE

More than 95% of the Development Footprint will be on land considered to have low to very low agricultural capability, which will limit the impacts to productive agricultural land within the Project Site and Far West and Orana regions. The Project involves the temporary modification of land use of up to 3,058.08 ha (Development Corridor), which accounts for just 0.01% of all land used for agriculture in the Far West, for the duration of the Project life.

Measures to mitigate potential impacts of the Project are summarised in Section 6.10.3.

6.10.1. Existing Environment

6.10.1.1. Geology, Soil and Soil Landscapes

GEOLOGY

The Project Site is located within the Lachlan Fold Belt region of NSW. The local geology is dominated by heavily folded Devonian aged (approximately 419 to 359 million years ago, Ma) rocks of the Crudine Group and Cunningham (Figure 6-43). The Crudine Group comprises a series of low-grade, volcanic-influenced metasedimentary rocks, primarily rhyolitic volcaniclastic sandstones with lesser tuff and fine-grained metasediments. The overlying Cunningham Formation comprises primarily fine-grained marine metasediments, with lesser sandstone and tuff. These rocks form a series of north-south trending, steeply dipping synclines, and anticlines across the majority of the Project Site. These structures and their impact on the topography of the Project Site is clearly visible from satellite imagery.

The northern extremity of the Project Site is dominated by Silurian-aged volcaniclastic sandstone of the Piambong Formation (approximately 415 Ma) containing Devonian monzodiorite intrusive sills. Minor outcrops of younger rocks, including Permian sediments of the Gunnedah Basin and Tertiary basalts, occur in the southwest of the Project Site on the western edge of Burrendong Dam.

NSW Geoscience Mapsheet 'Euchareena 1:100,000' (Morgan E.J., 2000), outlines the geology of the Project Site, including a geologic cross-section of the region. Major lithological units are listed in Table 6-72.

Table 6-72: Underlying geological units

Geological Unit	Age	Summary
Gunnedah Basin	Permian	Carbonaceous siltstone, quartz-lithic, conglomerate and coal lenses, rare varves
Mudgee River Granite	Carboniferous	Biotite granodiorite, biotite-quartz monzodiorite, monzonite
Cunningham Formation	Devonian	Phyllite, slate, shale, siltstone, quartz-feldspar-lithic-calcareous sandstone, tuff
Crudine Group	Devonian	Rhyolitic to dacitic volcaniclastic sandstone, siltstone, phyllitic shale, paraconglomerate, tuff, minor lava, and ignimbrite
Piambong Formation	Silurian	Rhyolitic, felstitic and latitic volcaniclastic and quartz lithic sandstone, siltstone, breccia, crystal and vitric tuff, minor lava

The eastern boundary of Burrendong Dam follows the Ilgingerry thrust fault, which trends north south and dips east. No other major faults are mapped in the Project Site. There is significant gold occurrence south-west of the Project Site, where the historic Stuart Town goldfields were located, but only minor mapped occurrences of gold within the Project Site, primarily along the eastern edge of Burrendong Dam.

There are no known karst features within the Project Site, although they are known to exist within the greater region. No significant occurrence of potentially karst-bearing limestone or dolomite rocks has been identified in the Project Site.

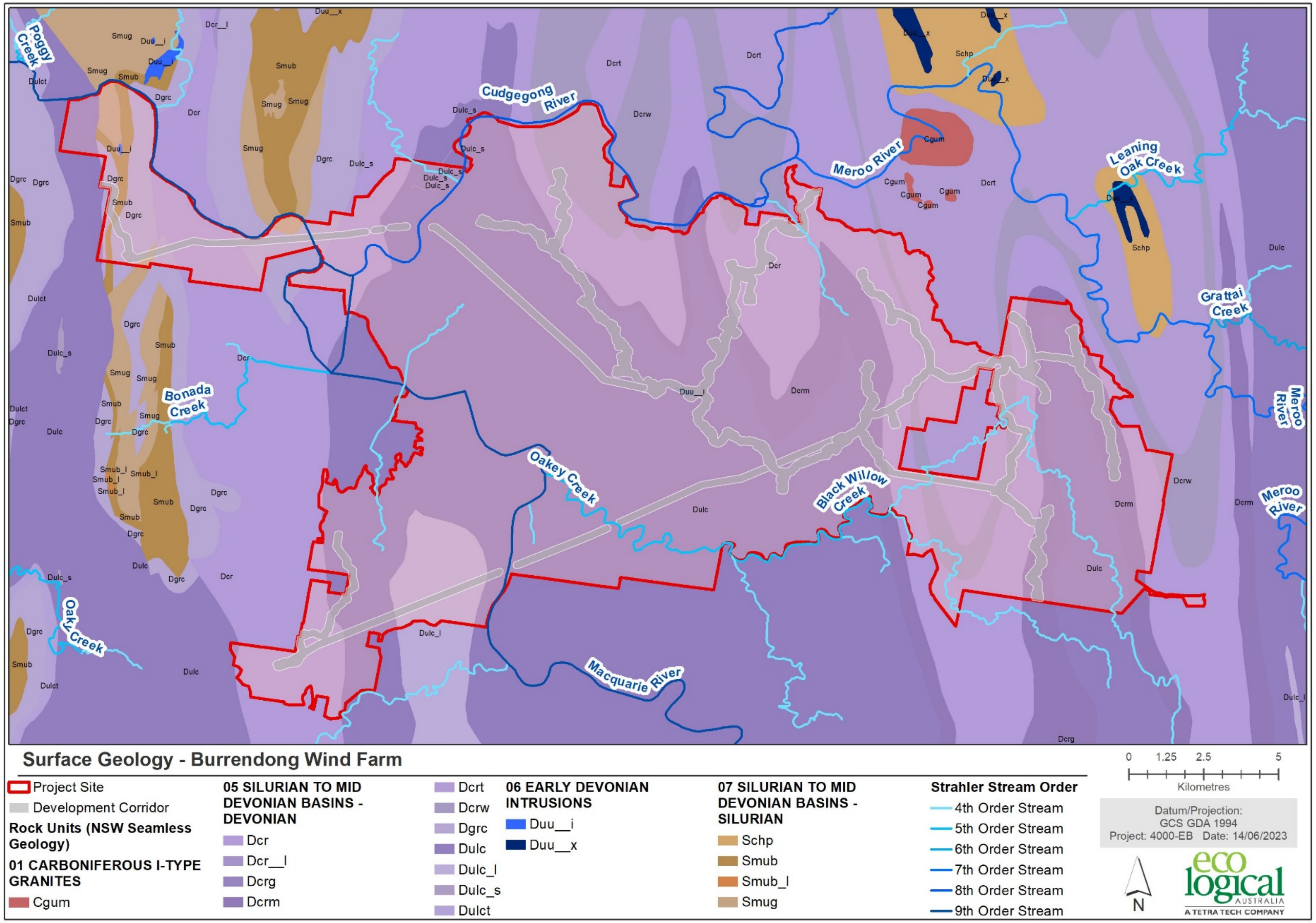


Figure 6-43: Surface geology of the Project Site

CLIMATE

The Project Site is located within the Central West Catchment Management Board Area of the NSW South Western Slopes Bioregion and is dominated by a sub-humid climate that is characterised by warm to hot dry summers and cold winters, dictated by the topographic gradients of the foothills of the Lachlan Fold Belt. Rainfall varies across the bioregion with high (1200 mm) mean annual rainfall in the east and less in the west (400 mm mean annual) (NSW Environment, 2016). Climate data was collated from the Bureau of Meteorology (2023) for monthly rainfall at Mumbil – Burrendong Dam (within 3 km of the Project Site boundary) and BoM weather station at Wellington (Station 065034) for temperature, about 12 km west of the Project Site.

The temperature statistics from BoM (2023) show January is the hottest month with an average maximum temperature of 33.0 °C and the average minimum is 17.1 °C. In winter the coldest month is July with an average minimum temperature of 2.2 °C and maximum of 15.3 °C. The long-term average rainfall at Mumbil – Burrendong Dam is 678 mm. Rainfall tends to occur mostly in January with a monthly average of 71 mm. The driest season is in April with an average of 45.2 mm of rain (BoM, 2023).

Average monthly rainfall and temperatures are illustrated below in Table 6-73.

Table 6-73: Mean monthly temperatures and rainfall for the Project Site

Mean		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly Average Temperature (°C)	Max	33.0	32.1	29.3	24.6	19.8	16.0	15.3	17.0	20.8	24.9	28.4	31.5
	Min	17.1	16.7	14.0	9.5	5.7	3.5	2.2	2.9	5.4	8.7	12.3	15.1
Monthly Average Rainfall (mm)	Total	71.1	60.1	58.4	45.2	49.0	47.5	54.3	52.3	52.3	58.9	66.5	59.9

SOIL LANDSCAPES

The Project is located within 8 different categories within the Soil Landscapes of Central and Eastern NSW that describe the general soil and landscape properties and their constraints. There are 2 key soil landscapes impacted by the Project, Burrendong (bd) and Mookerawa (mk). Other soil landscapes in the Project Site are minimally impacted (collectively, less than 5% of the Project Site). These soil landscapes include Bakers Swamp (bs), Erudegerie (er), Red Hill (rh), Macquarie-Dubbo (md, Nanima (na), and Collingwood (cg). A description of the soil landscapes found within the Project Site is provided in Table 6-74, with the location of the soil landscapes shown in Figure 6-44.

Table 6-74: Soil Landscape Characteristics within the Project Site

Soil Landscape	Characteristics	Project Site		Development Corridor	
		ha	%	ha	%
Burrendong (bd)	The bd soil landscape is characterised by rolling to steep hills with rocky outcrops common. Slope lengths vary from 200 – 800 metres and local relief ranges 40-200 m. This landscape can be found scattered between Wellington and Mudgee, including some ridges north-west to south-east in the vicinity of Burrendong Dam. Such land is generally suitable for light grazing or areas of native pastures or timber as the steep slopes create a high erosion hazard (Murphy & Lawrie 1998).	5584.42	19.27 %	476.82	15.59 %
Mookerawa (mk)	The landform within mk landscape areas tend to be undulating to rolling low hills and hills often dotted with quartz gravel. Slope lengths vary between 500-1200 metres in length with 8 – 30%, but on average less than 15%. This landscape is associated with Mullion Creek which together occupy large areas in the south-central part between Wellington and Mudgee. Areas include Euchareena, Burrendong Dam, Hargraves, Piambong and Goolma. Agricultural use is limited to conservation farming practices for cropping, or otherwise it is mainly suitable for grazing volunteer/native pastures (Murphy & Lawrie 1998).	17,330.32	59.80 %	2,362.34	77.25 %
Bakers Swamp (bs)	Areas in this landscape can be described as undulating low hills, with gently inclined slopes 6 – 10%, about 500 to 1000 metres long. Known to be located about 23 kilometres south of Wellington and extending about 15 kilometres south of Neurea. Local relief varies between 40 – 80 metres. Agricultural use includes dryland cropping (e.g., wheat or canola), improved pasture and some area of native pastures (for prime lambs, cattle, and wool) on ridges and hillocks (Murphy & Lawrie 1998).	222.21	0.77 %	14.92	0.49 %
Erudgerie (er)	Described as undulating low hills composed of foot slopes of sandstone hills and low flat-topped ridges within broad valleys. The angle of slopes is generally less than 5% with local relief between 20-40m and slopes being up to 2500 metres long. This landscape is found scattered in some locations in the vicinity of Burrendong Dam. Land is generally suited for grazing or conservation farming practices if fodder crops are grown (Murphy & Lawrie 1998).	280.79	0.97 %	39.99	1.31 %
Red Hill (rh)	This soil landscape can be found 8-10 kilometres east and south of Wellington. It is comprised of rolling hills and rocky outcrops with gentle slopes between 5-20% and 400-800 metres long. Due to the slopes, land is best suited to grazing, although soils support sown pastures (Murphy & Lawrie 1998).	860.98	2.97 %	80.23	2.62 %
Macquarie-Dubbo (md)	Macquarie-Dubbo landscapes are found in the direct vicinity of the Macquarie River, with majority of these areas occurring downstream from Wellington. Composed of alluvial plains and terraces, slopes are level to very gently inclined (0-3%) ranging from 100 – 4000 metres long. Local relief varies 0-10 metres. Often used for agricultural land with required nutrient inputs and conservation farming practices (Murphy & Lawrie 1998).	239.65	0.83 %	20.04	0.66 %

Soil Landscape	Characteristics	Project Site		Development Corridor	
		ha	%	ha	%
Nanima (na)	Nanima landscapes neighbour Red Hill (rh) and are scattered throughout belt country from 30 kilometres north of Wellington to 30 kilometres south of Wellington. Distinguished by rolling low hills with elevation between 300-550 metres, gentle to moderate slopes inclined 5-20% and 300-100 metres long. Local relief ranges from 80 – 150 metres and the land is generally used for grazing (Murphy & Lawrie 1998).	51.56	0.18 %	16.26	0.53 %
Collingwood (cg)	Comprised of rolling low hills and hills at 520 – 900 m elevation, with local relief between 400 – 800 m and slopes 10-15%. Often associated with small areas of Permian sediments, including one 10 kilometres west of Mudgee. Land is identified as mainly suitable for grazing (Murphy & Lawrie 1998).	180.60	0.62 %	12.07	0.39 %

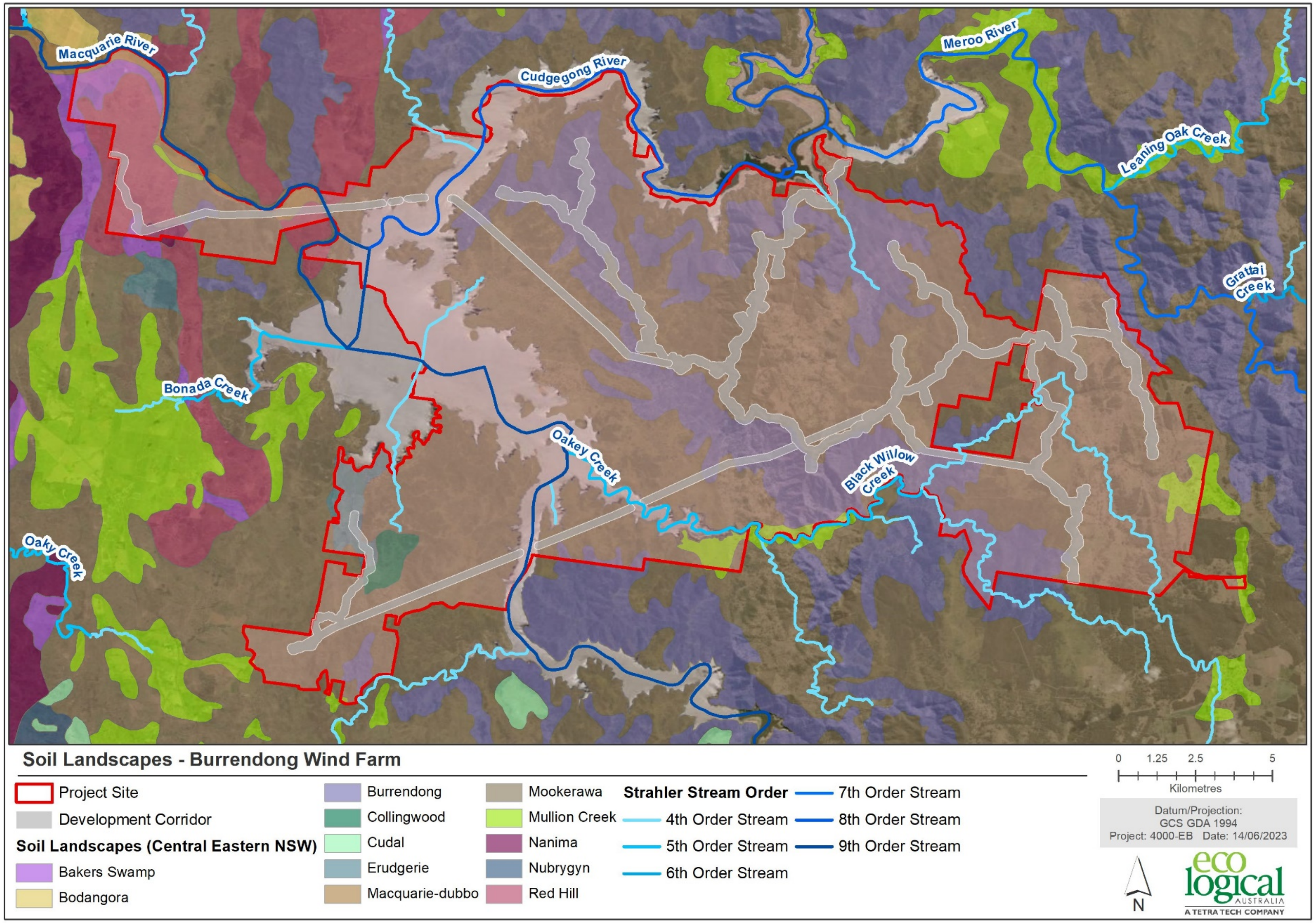


Figure 6-44: Soil landscapes within the Project Site

SOIL TYPES

The soils vary across the Project Site and reflect the changes in climatic gradients and geology. Seven (7) Australian Soil Classifications (ASC) were found across the Project Site (Table 6-75 and Figure 6-45). The soil types present in the Project Site according to the ASC are Rudosols, Kurosols, Chromosols, Sodosols, Dermosols, with smaller areas of Kandosols and ferrosols (eSPADE 2023).

Table 6-75: Australian Soil Classifications within the Project Site

Australian Soil Classification	Within Project Site		Within Development Corridor	
	(ha)	%	(ha)	%
Rudosols & Tenosols	5,592.49	19.3 %	476.87	15.6 %
Kurosols	446.50	1.5 %	52.07	1.7 %
Chromosols	1,083.97	3.7 %	95.15	3.1 %
Sodosols	409.74	1.4 %	0.00	0.0 %
Dermosols	257.56	0.9 %	20.84	0.7 %
Ferrosols	51.56	0.2 %	16.26	0.5 %
Kurosols, Natric	1,7297.36	59.7 %	2,362.82	77.3 %
Water	3,840.33	13.3 %	476.87	15.6 %
TOTAL	**28,979.21**	-	**3,058.08**	-

Table 6-76: Description of soil types within the Project Site

Soil Landscape	Soil Type (ASC)	Limitation
Mookerawa	Yellow Sodosols, Red Chromosols, Lithic Rudosols.	moderate to low fertility; sodic subsoils common on lower slopes; high to very high erosion hazard under cultivation.
Burrendong	lithic rudosols (shallow loams and sands) red chromosols, yellow sodosols, yellow kandosols.	steep slopes; very low fertility; rock outcrop; low water holding capacity
Mullion creek	Red Chromosols, Yellow Sodosols	low fertility; seasonal waterlogging; sodic subsoils on lower slopes; high erosion hazard under cultivation; acidic surface soils; salinity common on lower slopes; low permeability.
Erudgerie	Yellow Chromosols, Red Chromosols. Stratic Rudosols.	low fertility; moderate available water holding capacity; seasonal waterlogging on lower slopes; moderate to high erosion hazard under cultivation.
Red Hill	Red Chromosols, Red Dermosols, Lithic Rudosols	moderate to low fertility; areas of rock outcrop and shallow soils; weakly structured surface soils; moderate to low available water holding capacity; high to very high erosion hazard under cultivation.
Macqurie-Dubbo	Fluvial Stratic Rudosols, Black Dermosols, Black Vertosols, Red Kandosols, Red Chromosols, Yellow Chromosols	moderate fertility; moderate to high available water holding capacity; weakly structured surface soils; streambank erosion; flood hazard.
Nanima	Chromosols, Dermosols, Ferrosols, Kurosols (natric), Sodosols, Vertosols	Moderate fertility; friable surface soils; steep slopes often with rock outcrop; moderate to high available water holding capacity; very high

Soil Landscape	Soil Type (ASC)	Limitation
		erosion hazard under cultivation; moderate to high shrink swell potential; aggregated clays may leak in earthworks.
Collingwood	Red Chromosols, Yellow Chromosols, Brown Chromosols, Black Dermosols	moderate fertility; moderate available water holding capacity; very high erosion hazard under cultivation; seasonal waterlogging on lower slopes.

The two main soil landscapes within the Project site (Burrendong and Mookerawa) have identified soil erosion risks. The Yellow Soloths have severe gullying and tunneling risks, and the Rod Podzolic Soils are subject to sheet erosion when cleared of native vegetation. Brown Podzolic Soils have a moderate susceptibility to erosion (Murphy, Soil Landscapes of the Dubbo 1:250 000 Sheet (Burrendong & Mookerawa), 1998). The characteristics of the dominant soil types within the Project site are outlined in Table 6-76.

The steep slopes and the rocky outcrops throughout the Project site will affect foundations and pose a high erosion hazard risk, especially where surface cover is low (Murphy, Soil Landscapes of the Dubbo 1:250 000 Sheet (Burrendong & Mookerawa), 1998).

Slopes are sufficient to cause a high erosion hazard under cropping and when surface cover is low (grade 8 to 30% and slope length 500 to 1200 m). Erosion control requires the construction of soil conservation earthworks and or the adoption of conservation farming practices. Soils in drainage depressions are very susceptible to gully erosion without adequate protection from high runoff. The subsoils are sodic and dispersible, and once exposed to free water they can erode rapidly to develop moderate or even severe gully erosion (Murphy, Soil Landscapes of the Dubbo 1:250 000 Sheet (Burrendong & Mookerawa), 1998).

Mullion Creek and Collingwood soil landscapes occur with minor presence within the Project Site, however, are within proximity to the active Project areas.

When surface cover is low, Mullion Creek soil landscape is susceptible to high erosion on slopes and require the construction of soil conservation works. Soils in drainage depressions should be protected from runoff as there is a high likelihood of gully erosion during rainfall events (Murphy, Soil Landscapes of the Dubbo 1:250 000 Sheet (Burrendong & Mookerawa), 1998).

The Collingwood soil landscape is suitable for earthworks providing there is sufficient clay present. In sloping areas, there is a high to very high risk of erosion when the surface cover is low (Murphy, Soil Landscapes of the Dubbo 1:250 000 Sheet (Burrendong & Mookerawa), 1998). Table 6-77 details the erosion and movement soil hazards by the two dominant soil landscapes within the Project Site.

Table 6-77: Erosion and movement soil hazards by soil landscape

Soil Landscape	Soil Sub Type	Hazard Classification					
		Erodibility (topsoil)	Erodibility (subsoil)	Erosion Hazard	Structural Degradation Hazard	Shrink-swell Potential	Mass Movement Hazard
Mookerawa	Yellow Soloths	Mod-High	High	High	High	Moderate to low	Low
	Red Podzolic soils	Moderate	Moderate	Moderate	Moderate to High	Moderate to low	Low; minor slumping
Burrendong	Shallow Soils	Moderate	Low	High	High	Low	Moderate
	Red Podzolic Soils	High	Moderate	High	High	Moderate	Low
	Yellow Soloths	High	High	High	High	Moderate to low	Low

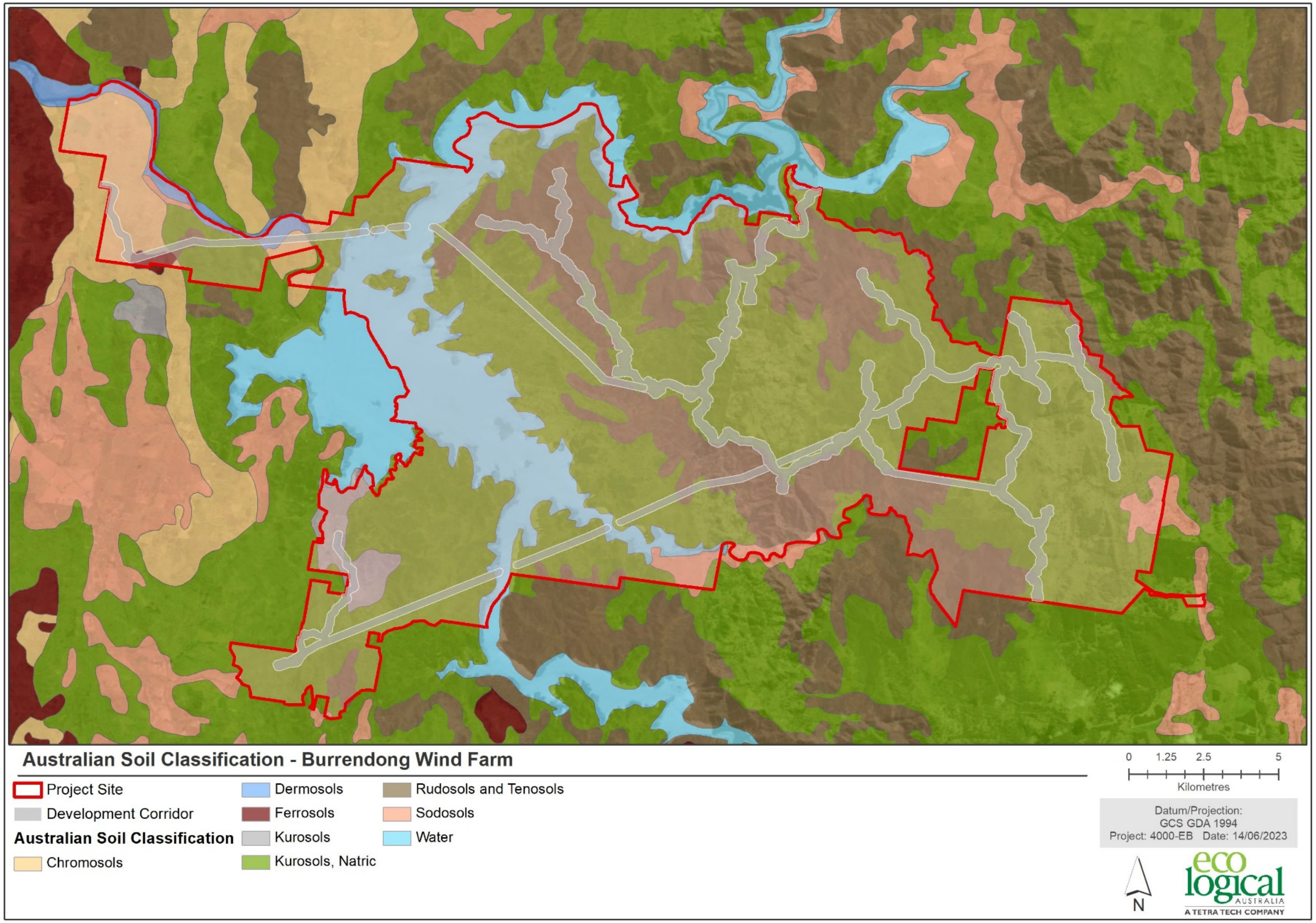


Figure 6-45: Australian Soil Classification of the Project Site

MITCHELL LANDSCAPE

The landscapes in NSW have been categorised into 'Mitchell Landscapes'; ecological units that are finer than bioregion scale. The primary Mitchell Landscape identified within the Project site is Ophir - Hargraves Plateau (Ohp) (Figure 6-46), of which there is 24,088.70 ha (83.1% of the total Project Site) within the Project Site. The remaining 16.9% of the Project Site are categorised in the following Mitchell landscapes (Table 6-78):

- Ophir – Hargraves plateau (83.1%)
- Macquarie - Turon gorges (4.3%)
- Mullion slopes (3.7%)
- Macquarie valley basalts (0.4%)
- Water (5.5%)
- Goonoo slopes (2.9%).

Table 6-78: Mitchell Landscapes within the Project Site

Mitchell Landscape	Summary	Within Project Site (ha)	Within Development Corridor (ha)
Ophir-Hargraves Plateau	Subdued strike ridges and dissected plateau on tightly folded Silurian and Devonian dacite, tuffaceous greywacke, crystal tuff, lithic sandstone and slate, general elevation 500 to 1000m, local relief 100 to 150m. Abundant rock outcrop with thin sandy loam grading to thin stony red texture-contrast soil on slopes and yellow harsh texture-contrast soil with bleached A2 horizons in valleys. Woodland to open forest of broad-leaved peppermint (Eucalyptus dives), red stringybark (Eucalyptus macrorhyncha), scribbly gum (Eucalyptus rossii), candlebark (Eucalyptus rubida), and yellow box (Eucalyptus melliodora) in lower positions. More northerly areas include red box (Eucalyptus polyanthemos), mountain grey gum (Eucalyptus cypellocarpa) and apple box (Eucalyptus bridgesiana)' (Mitchell, 2002)	24,088.70 ha	2,711.41 ha
Macquarie-Turon gorges	Steep sided, deep gorge tract with incised meanders of the Macquarie and Turon Rivers below extensive tablelands of the Ophir-Hargraves Plateau landscape. Incised across the structural grain of north-south trending tightly folded Devonian dacite, crystal tuff, quartzite and slates. General elevation 500 to 700m, local relief to 150m. Shallow stony soils on semi-stable scree slopes and yellow texture-contrast soils on lower angle slopes. Open woodland of yellow box (Eucalyptus melliodora), red box (Eucalyptus polyanthemos) and Blakely's red gum (Eucalyptus blakelyi) on lower areas, red stringybark (Eucalyptus macrorhyncha), broadleaved peppermint (Eucalyptus dives) and candlebark (Eucalyptus rubida), on higher slopes. River oak (Casuarina cunninghamiana) dominates the channel' (Mitchell, 2002).	1,243.63 ha	92.01 ha
Mullion slopes	Steep hills and strike ridges on tightly folded Ordovician andesite, conglomerate and tuff, Silurian rhyolite and	1,075.38 ha	132.40 ha

Mitchell Landscape	Summary	Within Project Site (ha)	Within Development Corridor (ha)
	shale, Devonian quartz sandstones, slate and minor limestone, general elevation 500 to 830m, local relief 200m. Stony uniform sand and loam in extensive rock outcrop along crests, stony red and brown texture-contrast soil on slopes, yellow harsh texture-contrast soil in valleys with some evidence of salinity. Gravel and sand in streambeds. Open forest to woodland of; white gum (Eucalyptus rossii), brittle gum (Eucalyptus mannifera), broad-leaved peppermint (Eucalyptus dives), red box (Eucalyptus polyanthemos), mountain grey gum (Eucalyptus cypellocarpa), white box (Eucalyptus albens) with yellow box (Eucalyptus melliodora) on lower slopes and river oak (Casuarina cunninghamiana) along the streams' (Mitchell, 2002).		
Macquarie valley basalts	Discontinuous flat-topped peaks and hillcrests on the upper margin of the Macquarie - Turon Gorges landscape with Tertiary flow basalts and underlying quartz sand and river gravel of a former Macquarie River. General elevation 700 to 750m, local relief 30m with the subbasaltic sands commonly 200 to 250m above the present river. Stony red-brown and yellow brown structured, friable loam. Open woodland with, long-leaved box (Eucalyptus nortonii), mountain gum (Eucalyptus dalrympleana), red stringybark (Eucalyptus macrorhyncha), narrow-leaved peppermint (Eucalyptus radiata) and grasses' (Mitchell, 2002).	124.23 ha	20.66 ha
Water	-	1,594.59 ha	1.17 ha
Goonoo slopes	Extensive undulating to stepped low hills with long slopes on sub-horizontal Triassic/Jurassic quartz sandstone, conglomerates, siltstone, shale and some coal. General elevation 300 to 500m with overall westerly slope, poorly defined drainage network, local relief to 30m. Stony yellow earths with sandstone outcrop on ridgelines to yellow harsh texture-contrast soils in shallow valleys. Broad-leaved ironbark (Eucalyptus fibrosa ssp. fibrosa) and black cypress pine (Callitris endlicheri) on ridges, broad-leaved ironbark, narrow-leaved ironbark (Eucalyptus crebra), red ironbark (Eucalyptus sideroxylon), fringe myrtle (Calytrix tetragona), spur-wing wattle (Acacia triptera), dainty phebalium (Phebalium obcordatum), daphne heath (Brachyloma daphnoides) on slopes with patches of green mallee (Eucalyptus viridis), Dwyer's mallee gum (Eucalyptus dwyeri) and broombush (Melaleuca uncinata). Grey box (Eucalyptus microcarpa), red ironbark (Eucalyptus sideroxylon), red stringybark (Eucalyptus macrorhyncha), fuzzy box (Eucalyptus conica) and Blakely's red gum (Eucalyptus blakelyi) with knob sedge (Carex inversa), and tall sedge (Carex appressa) along streams' (Mitchell, 2002).	852.65 ha	100.41 ha

TOPOGRAPHY

The Project Site takes advantage of the elevated ridges of the eastern boundary of Burrendong Dam. The region is dominated by high elevation ridgelines and undulating valleys trending north south. The WTGs are proposed to be located along the ridge lines within the Project Site to take advantage of the prevailing wind direction in and around Burrendong Dam and surrounding undulating landscape.

The topography of the Project Site is illustrated in Figure 6-47. The eastern flank of Burrendong Dam is more steeply undulating than the western flank, where the majority of dam recreation infrastructure is located. The topographic high within the Project Site is 1,112 m; the topographic low is 258 m. The elevation changes within the Project Site are significant for the region and are a result of the underlying geological morphology and subsequent erosion history.

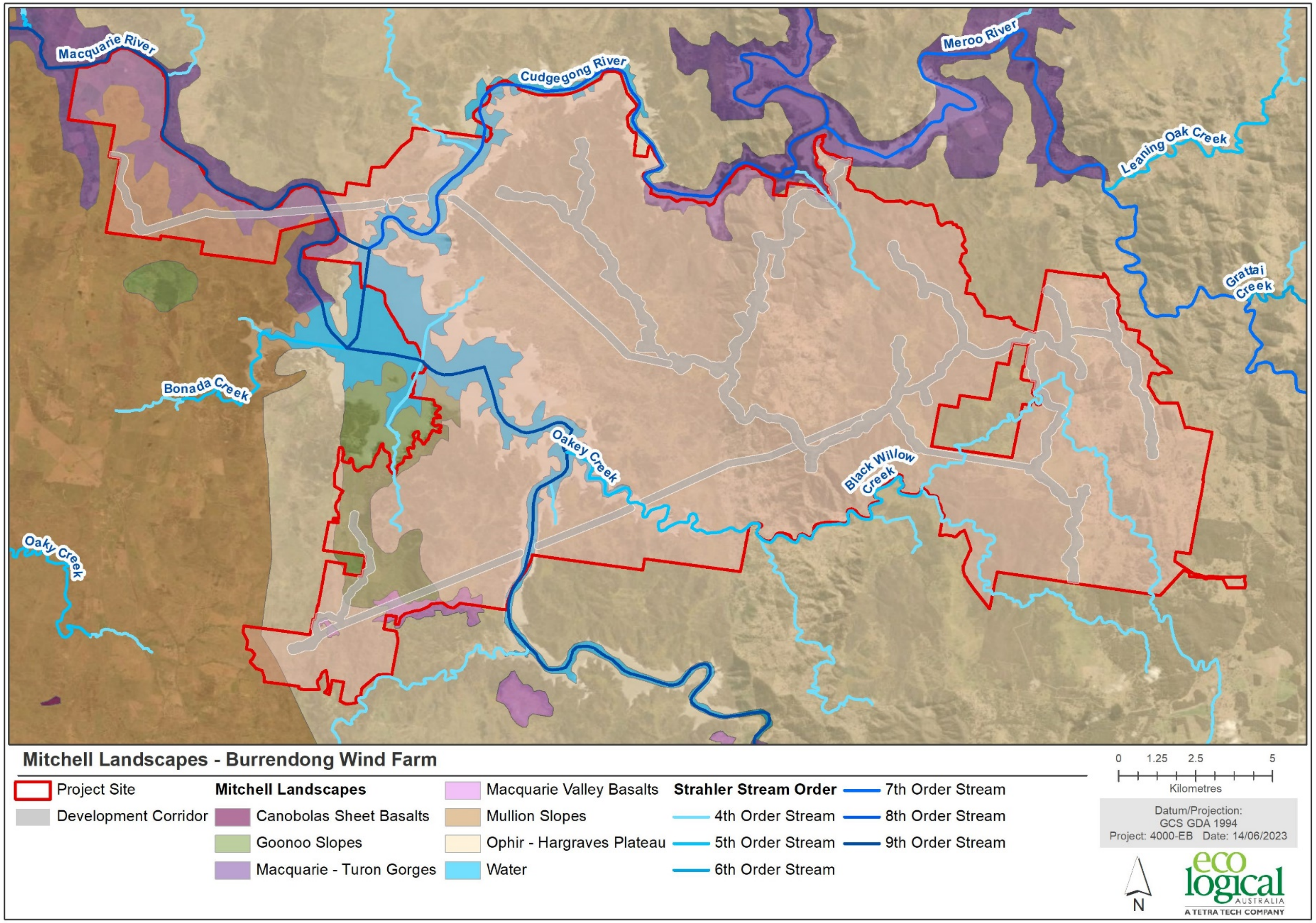


Figure 6-46: Mitchell landscapes within the Project Site

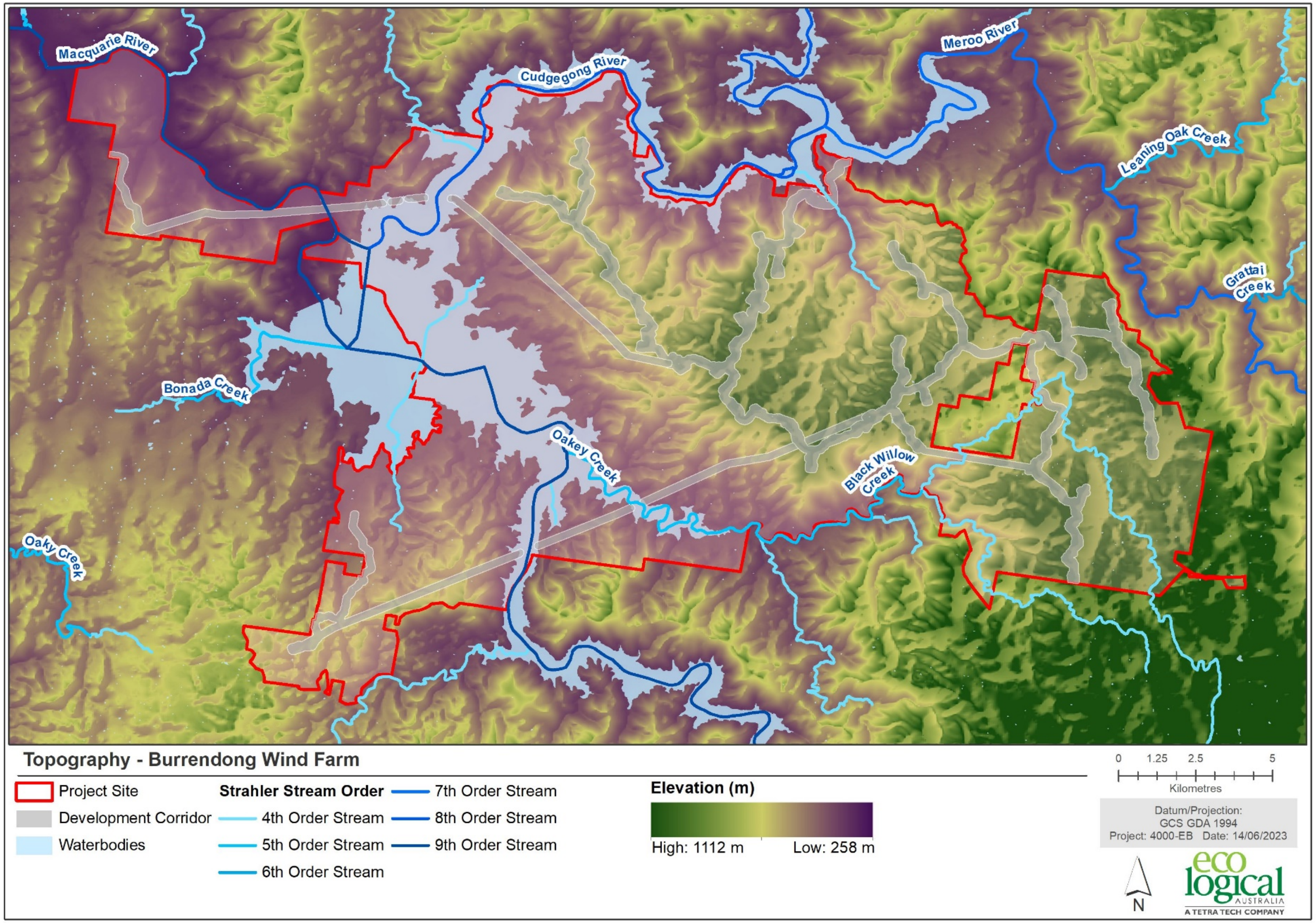


Figure 6-47: Topography of the Project Site

6.10.1.2. Salinity, Acid Sulphate Soils, Naturally Occurring Asbestos

SALINITY AND SODICITY

Salinity can occur because of clearing deep-rooted native vegetation and establishing shallow-rooted crops and pastures, which take up less water, leading to rising groundwater, bringing dissolving salts stored in the soil to the surface. The salinity across the Project Site is nil (DPIE, 2023b). The Hydrogeological Landscape (HGL) boundaries (NSW SEED, 2016) show the Project site has a generally low risk of land salinity, with small portions of medium risk and minor portions of high risk. However, (Murphy, Soil Landscapes of the Dubbo 1:250 000 Sheet (Burrendong & Mookerawa), 1998) states that high levels of soil salinity are apparent and common across the Project landscape. Landform elements more affected by salinity include drainage lines, depression, foot slopes, lower slopes and more rarely, mid, and upper slopes.

Sodicity is the amount of exchangeable sodium cations present in soil and is caused by the presence of sodium attached to clay in soil. A soil is considered sodic when the sodium reaches a concentration that starts to affect the structure of the soil. It related to the likely dispersion of soil upon wetting as well as the soil shrink swell properties. These properties impact how the soil behaves when disturbed.

HYDROGEOLOGICAL LANDSCAPE

Hydrogeological landscapes (HGL) are spatially labelled areas that contain similar salt stores and pathways for salt mobilisation. HGLs consider several factors, including geology, soils, slopes, regolith depth and climate (NSW Government, 2016) and are relevant to understanding hazard classifications at the Project Site. There are two (2) key HGLs present within the development corridor, being Euchareena and Stuart Town. There are also small areas of Dubbo Basalt East, Curga Burga Volcanics, Turtle, Dunedoo, Sun Top and Biranganbil. Each hydrogeological landscape is described in Table 6-79.

Table 6-79: Hydrogeological Landscapes within the Project Site

Hydrogeological Landscape	Description
Euchareena	This hydrogeological landscape makes up majority of the area and is characteristic of Devonian sediments, steep hills in upland areas and undulating/rolling low hills in the lower areas. Soils on the mid to upper slopes are often red podzolic soils and yellow soloths/solodics soils on lower slopes (DPE 2014; eSpade 2023). Salt sites are a key issue due to erosion processes; soils are sodic and highly erodible and often moderately acidic but overall land salinity and salt export is low with high water quality. This landscape is a vital surface water source and requires consideration of its constraints. These are soil acidity and sodicity (can make some exotic pastures unsuitable), low water holding capacity, gravelly soils, high erosion risk, limited accessibility to high slopes and steep areas reduces grazing suitability and make management more difficult (DPE 2014; eSpade 2023).
Stuart Town	Stuart Town is comprised from Devonian sediments, rounded undulating hills, low hills with flat valley floors and is like the Euchareena HGL. Red podzolic soils are most common on mid to upper slopes and yellow soloths/solodics soils on lower slopes (DPE 2014; eSpade 2023). These soils can be characterised as sodic, erodible, slightly acidic with overall moderate land salinity, salt export and water quality. Land management decisions are essential to influence salinity outcomes as this landscape is key to water quality and its offsite catchment implications (DPE 2014; eSpade 2023).
Dubbo Basalt East	Comprising a small area under the proposed transmission line to the south of the project site. This landscape is characterised by remnant small plateau, rolling rises and low hills with low angle slopes and wide valleys (DPE 2014; eSpade 2023). Soils range from dark reddish-brown clay loams and clays to medium or heavy clays. Land is generally used for cropping and grazing of improved pastures. Water

Hydrogeological Landscape	Description
	quality is high, land salinity and salt export moderate with management constraints requiring the need to balance salinity with water supply (DPE 2014; eSpade 2023).
Curga Burga Volcanics	This HGL is in the north-west of the project site where the alternate transmission line and towers are proposed. This landscape is characterised by rolling low hills with moderate inclined slopes and defined by structures and faults (DPE 2014; eSpade 2023). Soils are shallow on hilltops, and non-Calcic brown soils occur on the lower slopes. Primarily used for grazing with improved native pastures, and sometimes dryland cropping. Land salinity, salt export is both high with water quality being low. Management constraints include high salt level in discharge areas making it slow to revegetate (DPE 2014; eSpade 2023).
Turtle	With a high confidence level, Turtle landscapes are bare, rocky with low hills and rises and steep upper slopes with long lower colluvial slopes. Soils are often red podzolic higher up and red earths lower in the landscape (DPE 2014; eSpade 2023). Land salinity, salt export is both considered high with water quality being low. Large salt sites can be present with water often being too salty and toxic for stock. Topsoil is generally slightly acidic, erodibility moderate and soil structural degradation high. Generally used for grazing and cropping on lower slopes only. Constraints in this landscape include severe salt sites, revegetation difficulties and active management (DPE 2014; eSpade 2023).
Dunedoo	Generally surrounding south of Burrendong Dam, this HGL is characteristic of flat lying Permian sandstone, siltstone, and conglomerate bedrock areas. Features include flat-topped hills and low angle colluvial slopes on stepped landforms (DPE 2014; eSpade 2023). Mostly sandy loams, with clay loams in the B horizon. On the upper slopes, shallow siliceous sands are present, mid-slope red podzolic soils and on the lower slopes, yellow solodics soils. Land salinity, salt export is both high with water quality being low. Land use includes uncleared timber, nature reserves and grazing with some limited cropping. Constraints of this HGL include poor soil conditions for plant growth, difficulty revegetating salt sites and lower land value limiting investment (DPE 2014; eSpade 2023).
Suntop	Only forming a small area beneath the alternate NTL, this HGL can be described as undulating low hills, contrasted with steep timbered neighbouring landscapes (DPE 2014; eSpade 2023). Soils are extremely variable but are generally loamy sand and clay. In the steeper areas, land use is limited to uncleared native forest and minor grazing, with undulating slopes supporting large areas of cropping and improved pastures. Land salinity, salt export is both high with water quality being low. With high salt levels, revegetation can be slow (DPE 2014; eSpade 2023).
Biranganbil	This HGL forms a small area near the alternate proposed switchyard and NTL to the west. Landscape features contain hills (range forming), steep landscapes with small valleys with salt (DPE 2014; eSpade 2023). Soil are often red podzolic sands on upper slopes and yellow soloths soils lower and in depressions. Typically use for grazing of native pastures (extensively cleared), native timber and scrub with small areas of improved pastures. Land salinity, salt export and water quality are all moderate for this HGL. Constraints may include acid sites and discharge which can be difficult to manage (DPE 2014; eSpade 2023).

ACID SULPHATE SOILS

A review of acid sulphate soils (ASS) in the SEED database was undertaken. No ASS were identified within or in proximity to the Project Site. A review of the Australian Soil Resource Information System (AriS) online database shows the entirety of the Project Site is mapped as having low to extremely low probability of occurrence of potential acid sulphate soils. ASS often occurs along coastal areas, with inland acid sulfate soils occurring on inland waterways, wetlands and drainage channels that provide waterlogged, saline, and anaerobic conditions. As specific soil testing for ASS has not been conducted, the confidence interval is considered low and therefore potential for the occurrence of ASS still remains.

CONTAMINATION

The Contaminated Land Public Record provides information relating to contaminated sites, or other details required by the *Contaminated Land Management Act 1997* and the *Environmentally Hazardous Chemicals Act 1985.* A search of the Contaminated Land Public Record was undertaken on 4 July 2023 within both the Dubbo Regional Council and the Mid-Western Regional Council areas. The results of the search did not reveal any registered contaminated land sites within or surrounding the Project Site.

A review of premises currently regulated by an EPL under the POEO Act and premises that are no longer required to be licensed under the POEO Act did not reveal any identified premises within or surrounding the Project Site. No documented evidence has been found that indicates that land to be utilised by the Project would be contaminated. Whilst no registered contaminated land occurs within the Project Site, potential contamination associated with agricultural activities may exist on site. These include sheep dips, import and fill material, demolition of old buildings and stockpiling of wastes.

NATURALLY OCCURRING ASBESTOS

The Project Site is in the vicinity of geological units comprising serpentine minerals, with the potential for Naturally Occurring Asbestos (NOA) to be present. As shown in Figure 6-48, the vast majority of the Project Site does not contain the potential for NOA. However, there is a small patch within the centre of the Project Site that does contain low asbestos potential. The stretches of low potential asbestos are primarily focused to the west of the Project Site with patches to the north and east of the Project Site as well.

A review of the geological units in proximity to the Project Site using the SEED database is in proximity to potential NOA geological units (Figure 6-48) as follows:

- Greater than 5 km from the Oakdale formation which includes tremolite and minor chrysolite with low asbestos potential. The unit is to the west of the Project Site
- Greater than 5 km from the Cuga Burga Volcancis with low asbestos potential. The unit is to the northwest of the Project Site

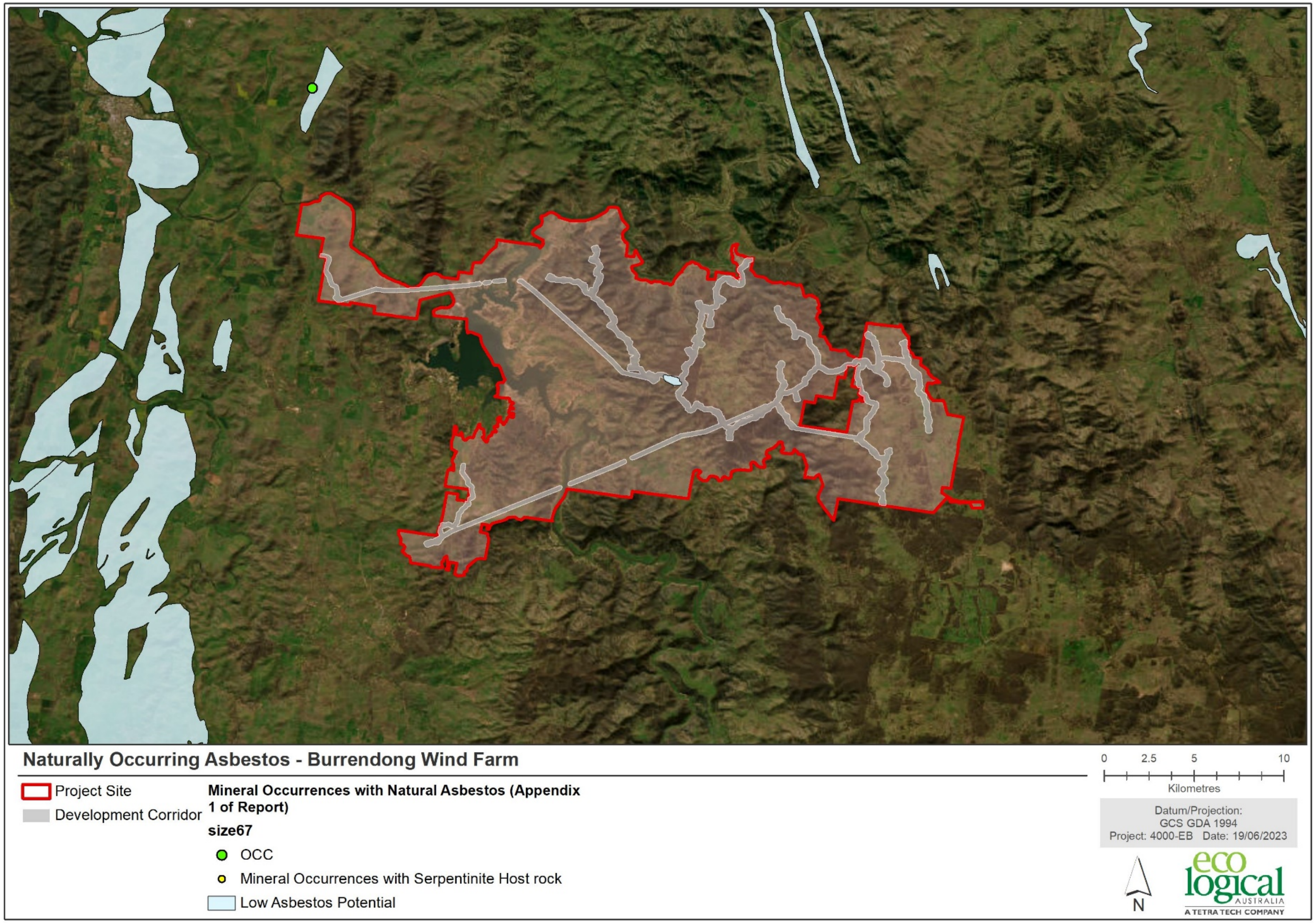


Figure 6-48: Potential naturally occurring asbestos within the Project Site

6.10.1.3. Air Quality and Emissions

LOCAL AIR QUALITY

The NSW EPA operates air quality monitoring stations at locations around NSW. No monitoring stations are located within the Project Site and therefore no air quality measurements have been undertaken specifically for the Project Site. Instead, the nearest available air quality monitoring data was used to gain an understanding of the existing pollutant levels that may occur around the Project Site and provide background air quality parameters for the assessment.

The closest monitoring station to the Project Site is the NSW EPA's Bathurst air quality monitoring station located approximately 95 km south. A representative year for the assessment has been selected based on the evaluation of weather monitoring stations and relevant data. Considering the limitations of regional monitoring, data from 2018 for the Bathurst station has been selected as sufficiently site-representative with the ambient pollutant levels for 2018 outlined in Table 6-80.

Table 6-80: Ambient Air Quality Data for Pollutant Levels 2018 (Benbow Environmental, 2023)

Pollutant	Averaging Period	Approved Methods Concentration Limit (µg/m³)	Concentration (µg/m³)
$PM_{2.5}$	Max 24 hours (15/12/2018)	25	40.5
	Annual	8	7
PM_{10}	Max 24 hours (15/12/2018)	50	274.1
	Annual	25	18.8

The data collected from the Bathurst air quality monitoring station in 2018 shows background levels of particulate matter with a particle diameter of 10 micrometres or less (PM_{10}) and particulate matter of 2.5 micrometres or less ($PM_{2.5}$) exceed the NSW EPA *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (2022) 24 hours average criterion. In instances of elevated background concentrations, the *Approved Methods* (EPA, 2022) states:

> *In some locations, existing ambient air pollutant concentrations may exceed the impact assessment criteria from time to time. In such circumstances, a licensee must demonstrate that no additional exceedances of the impact assessment criteria will occur as a result of the proposed activity and that best management practices will be implemented to minimise emissions of air pollutants as far as is practical.*

Benbow Environmental (2023; Appendix O) used the worst-case particle size distribution data provided by the U.S. Environmental Protection Agency (USEPA) AP-42 Emissions Database with a PM_{10} to TSP ration of 0.51. This ratio was used to estimate the Total Suspended Particulates (TSP) background concentration level of 22.9 µg/m³ for an annual averaging period.

METEOROLOGY

The nearest weather monitoring station operated by the Bureau of Meteorology (BoM) to the Project Site is the Wellington (D&J Rural) weather station and is approximately 23.41 km from the Project Site. The 5 most recent years of available data for temperature and wind run were compared to long term averages. The year 2018 was found to be the most representative with the data being input into the

CALMET program to create a 3D meteorological model of wind and temperature fields of the Project Site.

Wind rose plots show the direction from which wind is coming represented by triangles known as “petals”. The petals of the plots summarise data into 8 compass directions (i.e., north, north-east, etc.). The length of the triangles, or petals, indicates the frequency that the wind blows from the direction presented. Longer petals for a given direction indicate a higher frequency of wind from that direction. Furthermore, each petal is divided into segments, with each segment representing one of the 6 wind class speeds. Where periods of time experience wind speed equal or less than 0.5 m/s, or negligible, they are referred to as “calms” and are not shown on wind roses are there are no directions, but they are noted under each rose as a temporal percentage.

Figure 6-49 - Figure 6-53 show seasonal wind rose plots for the Project Site using non-observational site-specific data for the year 2018. Average annual wind speeds of 4.84 m/s were recorded with a calm’s frequency of 3.15%. Annual winds from the east were found to be the most frequent, with a frequency of 28% of total wind speed directions, followed by south-westerly winds at approximately 13%. Table 6-81 outlines the seasonal average wind speeds and most frequent wind directions.

Table 6-81: Average seasonal wind speeds and dominant wind direction for the Project Site (Benbow Environmental, 2023)

Seasonal Period	Average Wind Speed (m/s)	Dominant Wind Direction and % of total	Calms Frequency (%)
Annual	4.84 m/s	Easterly, 28%	3.15%
Summer	5.12 m/s	Easterly, 33%	2.18%
Autumn	4.65 m/s	Easterly, 34%	4.21%
Winter	4.59 m/s	Westerly, 20% and Southerly, 20%	3.53%
Spring	5.02 m/s	Easterly, 30%	2.66%

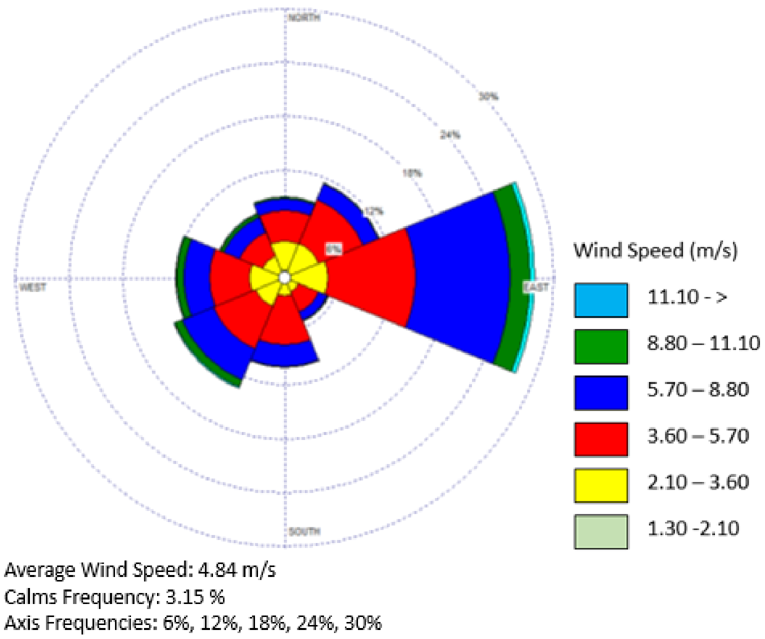


Figure 6-49: Annual wind rose for Project site using CALMET (Benbow Environmental, 2023)

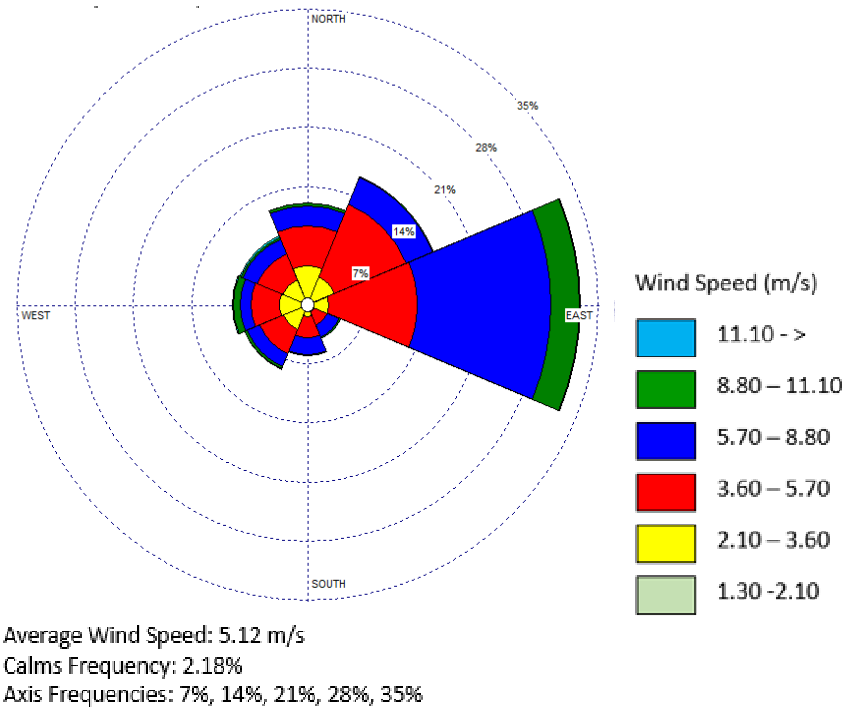


Figure 6-50: Summer (Dec - Feb) wind rose for Project site using CALMET (Benbow, 2023)

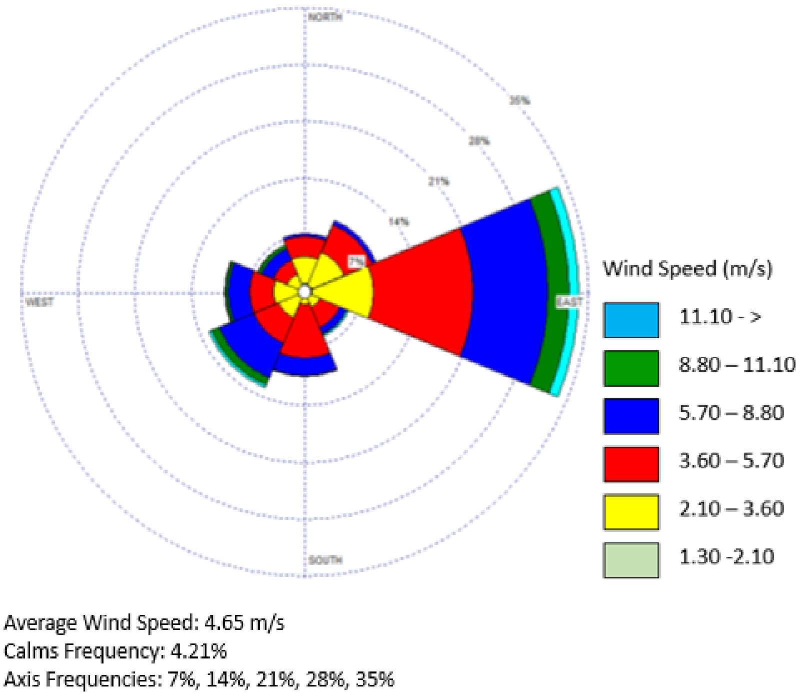
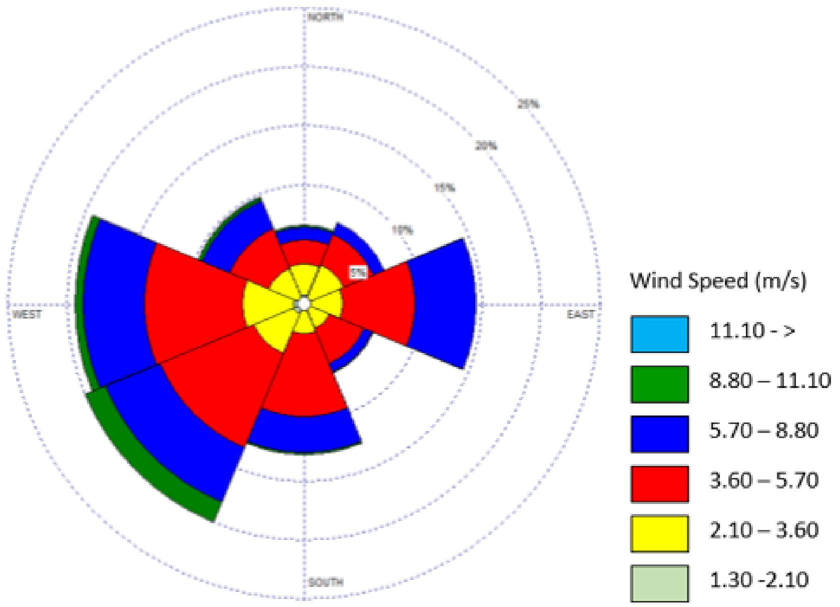
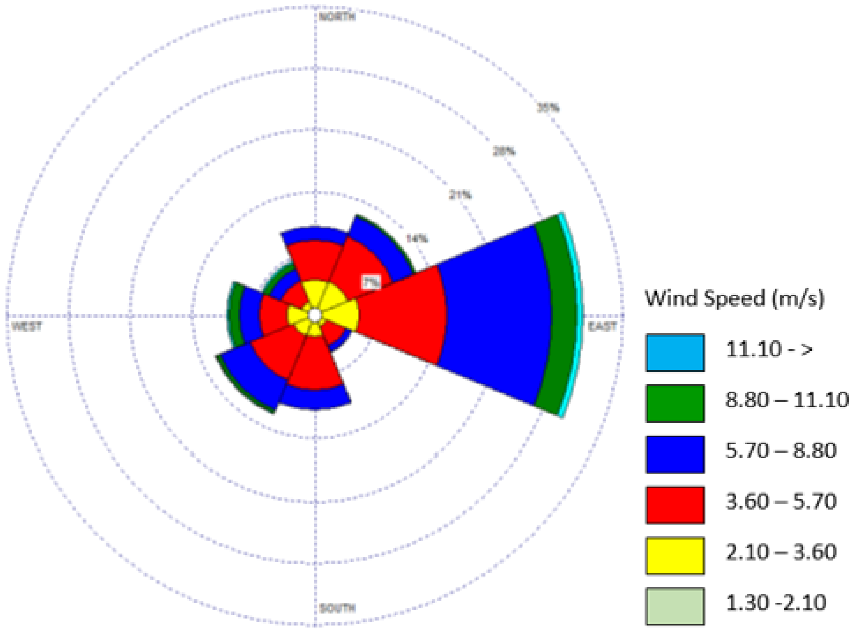


Figure 6-51: Autumn (Mar - May) wind rose for Project site using CALMET (Benbow, 2023)



Average Wind Speed: 4.9 m/s
Calms Frequency: 3.53%
Axis Frequencies: 5%, 10%, 15%, 20%, 25%

Figure 6-52: Winter (Jun - Aug) wind rose for Project site using CALMET (Benbow, 2023)



Average Wind Speed: 5.02 m/s
Calms Frequency: 2.66%
Axis Frequencies: 7%, 14%, 21%, 28%, 35%

Figure 6-53: Spring (Sept - Nov) wind rose for Project site using CALMET (Benbow, 2023)

Meteorology in the Project Site is consistent with a strong annual easterly wind axis, with a noticable south-westerly wind axis in the winter. Summer, Spring and Autumn all experienced similar wind direction with the only deviation occuring in Winter.

LOCAL CLIMATE DATA

The BoM website for the Wellington Station provided climate data for a range of statistics. Data on mean rainfall is provided from 1882 – 2022, mean maximum and minimum temperature is provided from 1907 – 2022 and daily wind data is provided from 1965 – 2010. The montly and annual average statistics are summarised in Table 6-82.

Table 6-82: Climate data from the Wellington Station (Benbow, 2023). Numbers in red denote the highest average measurement for the associated year, while numbers in blue denote the lowest average measurement

Month	Mean Max Temp (°C)	Mean Min Temp (°C)	Daily Wind Run (km)	Mean Rainfall (mm)
January	**33**	**17.1**	9.9	**60.1**
February	32.1	16.7	9.3	51.2
March	29.3	14	8.5	51.9
April	24.6	9.5	7.3	45.5
May	19.8	5.7	**7**	46.8
June	16	3.5	7.2	50.8
July	**15.3**	**2.2**	9	49.2
August	17	2.9	10.1	48.9
September	20.8	5.4	10.6	**45.1**
October	24.9	8.7	**11.7**	56.8
November	28.4	12.3	11.3	58.5
December	31.5	15.1	10.6	56.2
Annual	**24.2**	**9.4**	**9.4**	**620.2**

6.10.1.4. Land Use and Agricultural Land

The primary land uses within the Project Site are shown in Figure 6-54. Primary land uses are grazing on native pasture (Murphy, Soil Landscapes of the Dubbo 1:250 000 Sheet, 1998) and managed resource protection. Significant neighbouring land use is Burrendong Dam, which holds waters from the Macquarie River and its tributaries.

The Project Site incorporates a minor portion of the Burrendong Dam (recreationally known as Burrendong Lake). The capacity of Burrendong Dam is 1,190,000 ML and is located within the Murray-Darling basin. It is the only dam along the entire length of Macquarie River and is regulated by the *Water Sharing Plan for the Macquarie and Cudgegong Regulated Rivers Water Source 2016* (DPIE, 2015) and Water NSW. Due to the size and accessibility of the dam, it is a popular recreation ground which is primarily accessed via Wellington, from the western flank of the dam.

The Project Site is comprised of several elevated ridges, with nearby land mainly used for sheep grazing and other agriculture activities the dominant land use. It is proposed that these existing uses will continue with minimal interruption from the Project's construction and operation.

Other mapped land use includes grazing on modified pastures, cropping in the northern extremity of the Project Site, residential and farm infrastructure in the eastern extremity, and other minimal use.

The most relevant locality to the Project Site is Hargraves, with 300 people counted in the 2021 Census. Sheep farming was the largest employment industry, with 23.3% of the total working population engaged in the sheep farming industry (ABS, 2021).

Goal 1 of the Central West Orana Regional Plan (DPE, 2022a) is to aspire to be the most diverse regional economy in NSW. Directives under this goal include a variety of focus areas to protect and support growth in existing industries (which are traditionally agriculture), as well as specific directions to diversify the region by sustainably managing mineral resources and increasing renewable energy generation (Planning NSW, 2019).

Located within the pilot Central-West Orana REZ, the NSW State Government has identified Dubbo and Wellington as areas of focus to accelerate the development of renewable energy sources.

The Central West and Orana region is the third highest contributor in NSW to Gross Value of Agriculture Production (GVAP) with a value around $1.77 billion, which accounts for 13.5% of NSW total GVAP (DPI, 2020). Broadacre cropping, meat and wool are the three highest contributing industries to the Central West and Orana GVAP. Diversification of the region is intended to create a 'stronger, more diverse economy (that) will facilitate the planning and commitment to care for the environment and improve sustainability' (Planning NSW, 2019).

The Project Site is zoned as RU1 (Primary Production) and C3 (Environmental Management), with a minor SP2 zoning to the North which corresponds with a tourist park (Figure 4-3). The Project is located within both the Dubbo Regional Council formerly (Wellington and Dubbo Shire Councils) and Mid-Western Regional Council (Figure 1-1).

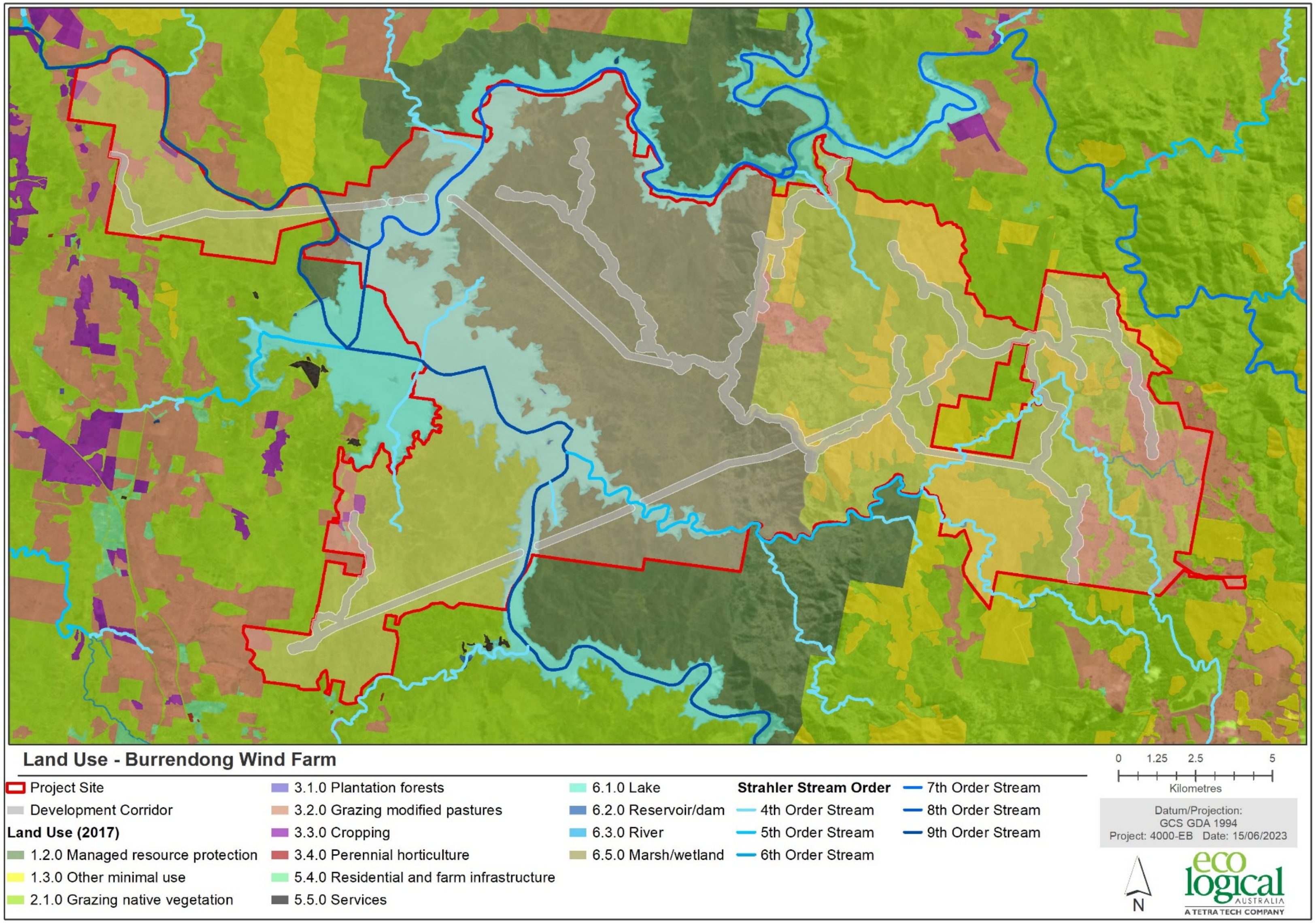


Figure 6-54: Land use types within the Project Site

LAND AND SOIL CAPABILITY AND BIOPHYSICAL STRATEGIC AGRICULTURAL LAND

Land capability is characterised by underlying geological features, soil grouping, slope, and topography. The classification of land is based on biophysical features which determine the limitations and hazards of that land, including water and wind erosion, soil structure decline, soil acidification, salinity, waterlogging, shallow soils, rockiness, and mass movement. Land and Soil Capability (LSC) mapping can be used to understand the land use and management required for different LSC land based on the physical capability of that land.

The Land and Soil Capability Assessment Scheme (OEH, 2012) is an 8 class system which recognises four (4) types of land uses with land capability decreasing from Class 1 to Class 8:

- Class 1 – 3: Land suitable for cultivation;
- Class 4 – 5: Land suitable for grazing and restricted cultivation;
- Class 6: Land suitable for grazing
- Class 7 – 8: Land not suitable for agricultural production

Land capability mapping shows that over 60% of Project Site is mapped as low capability land (LSC Class 6) with very severe limitations for high impact land uses such as cropping with cultivation, and land use restricted to grazing (Table 6-83; Figure 6-55). Land capability mapping shows the Project Site also contains very low capability land (LSC Class 7) on elevated ridges (19%). Portions of the Project Site are mapped as containing LSC Class 3, 4 and 5 soils, which contain moderate to highly capable land.

Biophysical Strategic Agricultural Land (BSAL) is land with high quality soil and water resources capable of sustaining high levels of productivity (DPIE, 2020a). A small portion of BSAL occurs within the northern portion of the Project Site (3.4 ha). The location of the BSAL regarding the Project Site involves land proposed for the alternate north transmission line and will allow for continued grazing to occur beneath the transmission line following construction.

Table 6-83: Areas of land capability classes within the Project Site

Land and Soil Capability Class	Area within Project Site		Area within Development Corridor		Area within Development Footprint	
	(ha)	%	(ha)	%	(ha)	%
3	479.76	1.62	35.76	1.1	7.29	0.9
4	180.59	0.62	12.07	0.4	1.56	0.2
5	675.64	2.33	39.99	1.2	4.79	0.6
6	18,210.37	62.84	2,459.31	73.4	645.62	82.3
7	5,592.48	19.29	746.87	22.3	118.34	15.1
Water	3,840.32	13.3	34.07	1.0	3.36	0.4
TOTAL		-	3,348.87	-	784.36	-

STATE SIGNIFICANT AGRICULTURAL LAND

As stated by the NSW Department of Primary Industries, agriculture remains central to NSW's food security and economic prosperity. To effectively determine rural land suitable for high levels of agricultural production, DPI has developed agricultural mapping to help identify and preserve the valuable resource of high productivity agricultural land. This has culminated in the draft State Significant Agricultural Land (SSAL) map that provides statewide identification of SSAL. The SSAL map is currently in draft form (as of October 2023) and is derived from existing statewide information where the most relevant characteristics related to the best agricultural land are used (DPI, 2023).

The mapping of SSAL also includes areas identified as BSAL as this data identifies the inherent land and water resources that are important on both a national and state level for agriculture. As seen in Figure 6-55 and Figure 6-56, BSAL land is intrinsically linked with SSAL land as they both represent highly productive agricultural land within the Project Site and beyond. The development of this mapping program is designed to assist both state and local governments, as well as other organisations such as the Proponent, to recognise and consider the importance of high productivity agricultural land when planning development in proximity to SSAL land.

MINING AND EXPLORATION

Within the Project Site, there are two Exploration Licences as available via MinView (NSW Geoscience, 2021) that are significant within the Project Site (Figure 6-57). EL9032 and EL8967 lie within the bounds on the Project Site and appear to be non-commercial operations. On the western flank of Burrendong Dam, there are multiple Exploration Licences. EL9032 are looking to explore Group 1 minerals (metallic minerals).

At the southwestern extremity of the Project Site, there is an operational Mining Lease – ML1035. The hobby mine is named Bald Hill, which is not to be confused with the historic Bald Hill mine located at Hill End. The Mining Lease mines an estimated 100 oz of gold annually, from an extrusive volcanic basalt from the Cenozoic Igneous Province of the Serravallian age (13.82-11.63 ma). The area was mined for alluvial gold from 1850-1870 and has been mined via a tunnel with a crusher and sluice since the 1980's.

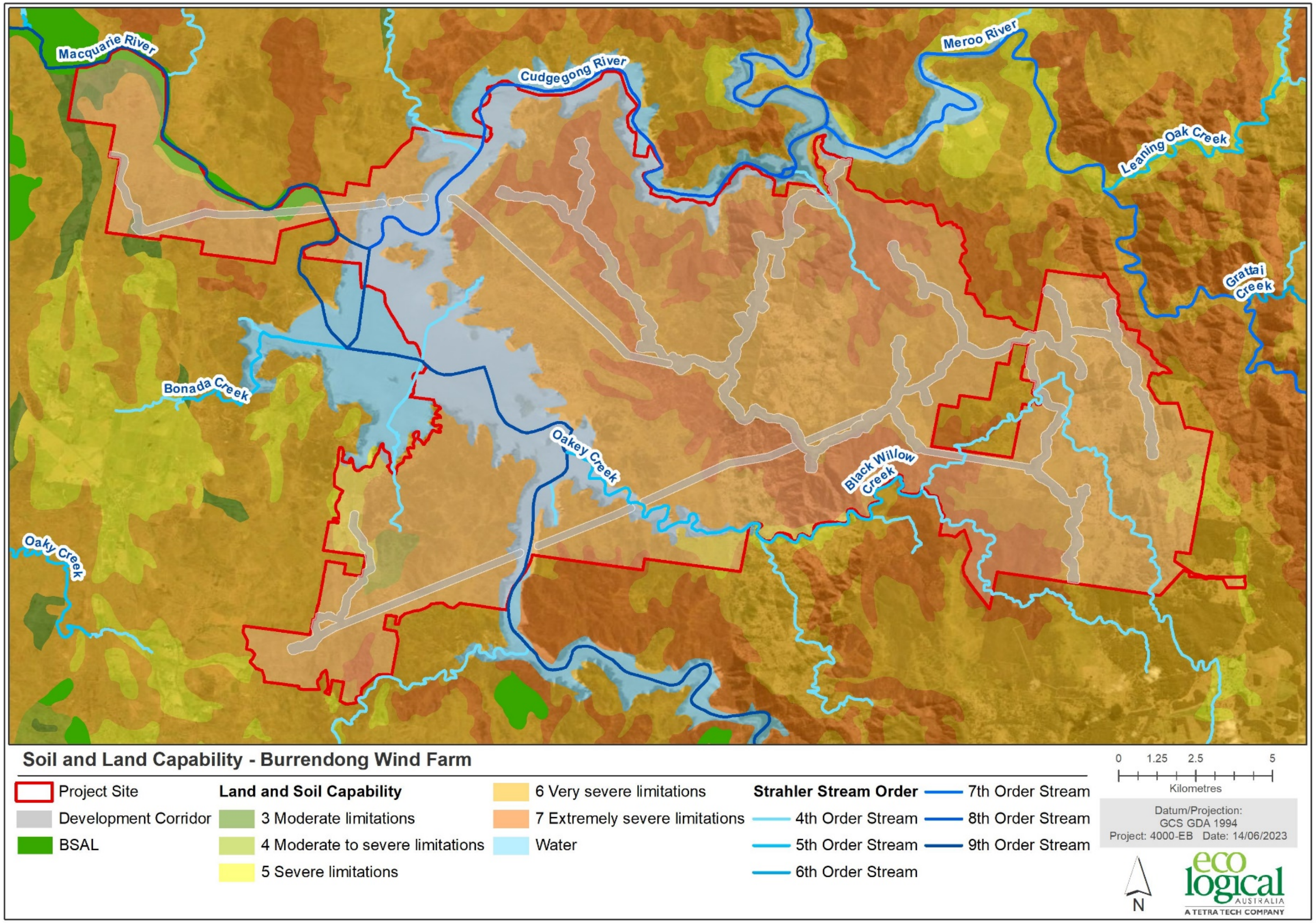


Figure 6-55: Land and soil capability classes within the Project Site

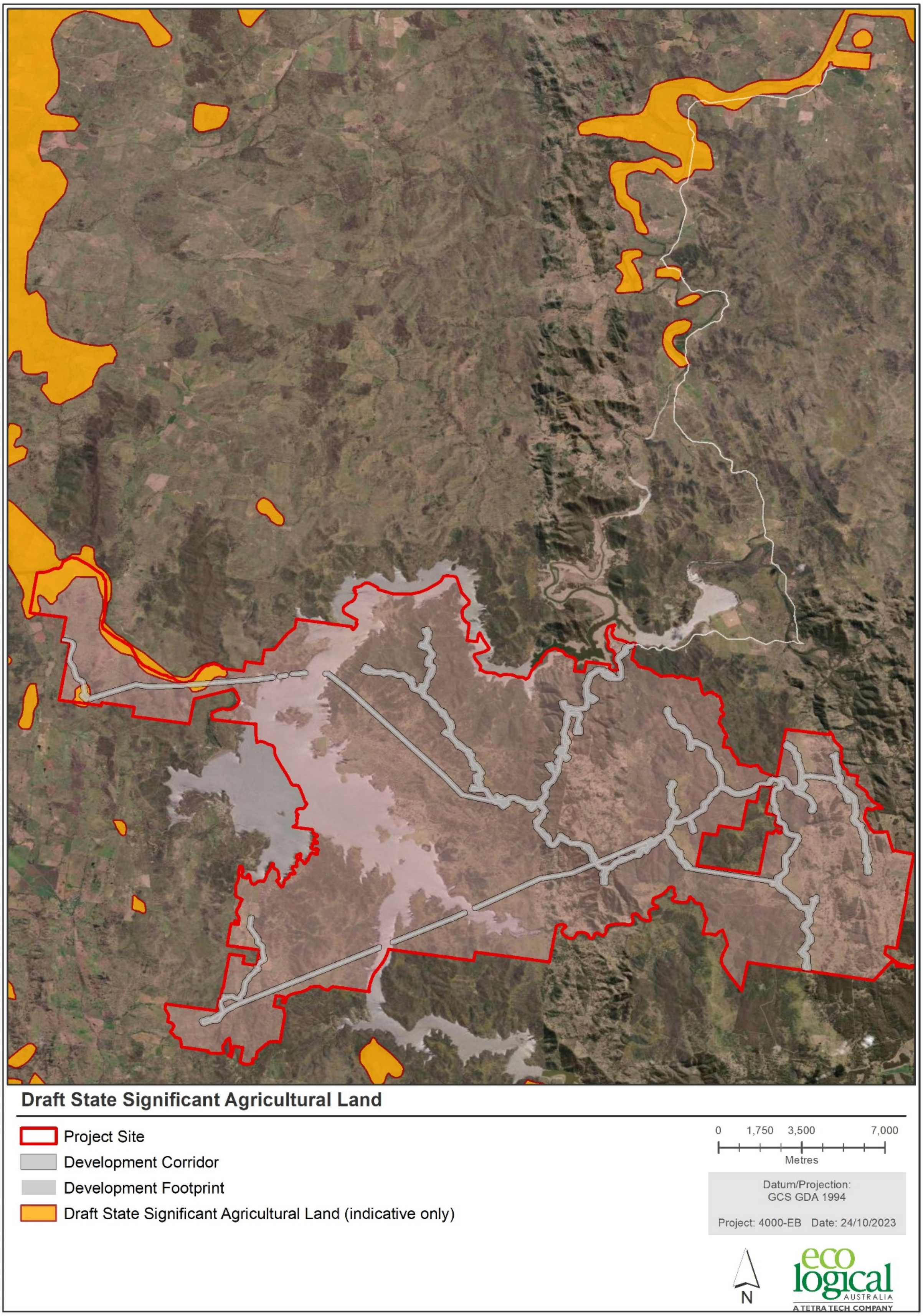


Figure 6-56: Draft State Significant Agricultural Land within and in proximity to the Project Site

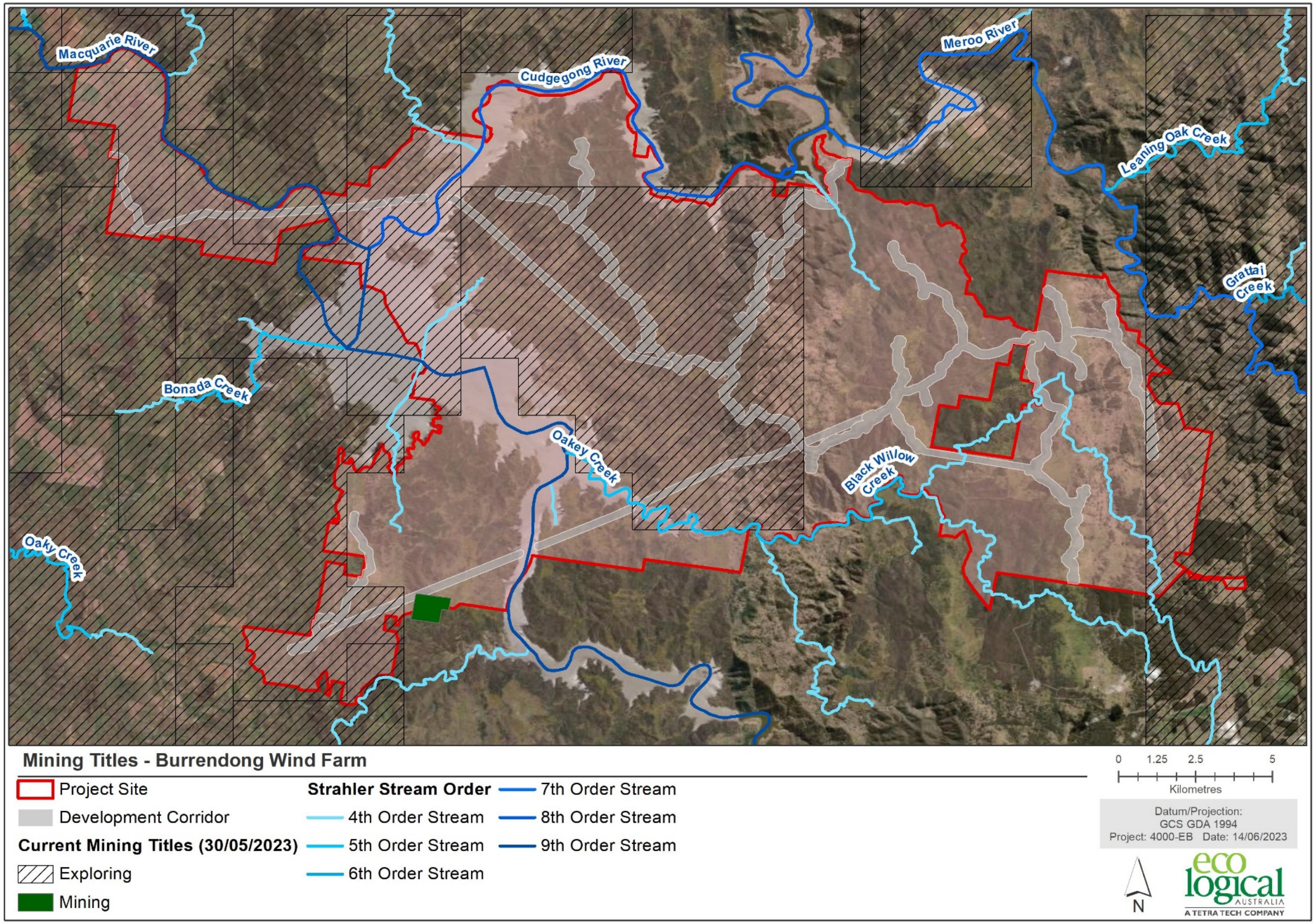


Figure 6-57: Mining and exploration titles within the Project Site

LAND USE CONFLICT

As part of the Land Use Conflict Risk Assessment (LUCRA), Tucker Environmental (2023; Appendix P) undertook soil samples and consultation with landowner, the local community, and other stakeholders.

The Project Site was visited on the 30th and 31st of May 2023, to undertake soil samples and investigate the location of Burrendong Wind Farm.

It is proposed that some areas of the existing primary land use of the Development Footprint will change from agriculture to electricity generating works through the development of a wind farm. Although agriculture and grazing can still occur beneath WTGs in most areas, it will constrain a small area of land from agricultural use (approximately 508 ha) and managed resource protection (approximately 287 ha). Land use zoning will not require change as the development is allowable on the existing land use zoning (RU1) with approval.

COMPATIBILITY WITH SURROUNDING LAND USES

The development of the Project would change existing land uses to renewable energy generating works, making it different from the surrounding grazing land use. However, although not consistent, it is compatible with co-use both for grazing and wind energy production as livestock can graze beneath the WTGs and only a small portion of land (WTG footprint and supporting infrastructure) will not be available for agricultural production. It is also within the Central West Orana REZ with which it is compatible. These REZs around NSW seek to cluster wind and solar power generation activities and projects into suitable locations where energy can be stored efficiently and transmitted across the state. This is one of five zones across NSW and will assist in delivering large amounts of new energy and lower wholesale electricity costs (EnergyCo, 2022). Taking into consideration the identified Project impacts and potential issues that require mitigation measures, the below LUCRA assesses the relevant environmental and amenity risks that remain.

6.10.2. Potential Impacts

6.10.2.1. Geology, Soil and Soil Landscapes

There are three impact phases to the geology, soils, and soil landscapes of the Project. Construction, operation, and decommissioning have individual impacts determined by the activities occurring within the phase, however in summary the major impacts will be from the clearing of vegetation and earthworks associated with building WTGs and the associated infrastructure.

CONSTRUCTION

With the potential to cause the greatest impact to soil, the construction phase will require the disturbance and/or removal of ground cover to construct WTG foundations and the associated infrastructure. Most soil landscapes within the Project Site have a high erosion hazard once the ground cover is removed; erosion and sediment control measures will be designed and implemented to minimise disturbance to ground as well as impacts to bare earth.

Micro-site scouting will be conducted pre-construction phase, to scope proposed locations for accessibility, environmental impact (with intent to minimise), safety, required earthworks and utilisation of existing morphology of the landscape. Each WTG location will be geotechnically investigated; the report of which will help determine the final design of the Project layout. Other areas of impact include the proposed substations, access roads, temporary laydown areas and underground cabling.

The WTG foundation size will be approximately 35 m in diameter, with depth determined by the geotechnical investigations. The foundation construction type will also be determined by the geotechnical investigation and may include variations of slab and/or rock anchor. The expected hardstand footprint of each WTG is approximately 35 m in diameter, which includes the foundation that the WTG is anchored to as well as the laydown perimeter. Due to the sloping topography and rocky outcrops within the Project Site, it is expected that the final footprint of infrastructure will be determined by micro-siting; and that each site may be slightly different in size and/or shape to accommodate the existing environment (including best practice soil management).

Due to the rocky nature of the existing environment, some rock blasting may be necessary to safely accommodate the WTG foundations. To be determined by geotechnical studies, the activity will require the removal of ground cover as well as the blasting of in-situ rock. Impacts will include the removal and management of topsoil and subsoil according to the soil types, as well as potential sedimentation during rainfall events.

Activities during the construction phase include clearing, earthworks, and trenching. These activities pose risk to the dominant soil landscapes within the Project site, as removal of ground cover creates hazardous conditions for erosion (sheet, gully, and rill). Removal of ground cover should be carefully designed and controlled according to the soil type/landscape to minimise damage and erosion risk. Sedimentation is a risk during rainfall events and should be managed with appropriate Erosion and Sediment Control (ESC) measures.

A lot of the impact during the construction phase will be temporary and relatively small areas (for example – trenching), allowing progressive rehabilitation to minimise erosion and sedimentation risk as soon as possible. The more permanent areas of disturbance, including WTG foundations, roads, laydown areas, and substations will be designed and constructed to minimise erosion and runoff. These structures will be decommissioned at the end of the Project life. Soil landscapes/type should be considered when designing ESC during construction, to ensure stability and viability of the soil profiles for the life of the Project.

The two primary soil landscapes within the Project Site (Burrendong and Mookerawa) have a very severe erosion risk (particularly water erosion) when ground cover is removed.

The process of ground disturbance will be of particular importance for the Project to ensure that where ground cover is removed, the topsoil and sub soil are managed with appropriate care. This includes the appropriate storage to minimise runoff from stockpiles and erodibility of exposed earth. The progressive backfilling of trenching and progressive rehabilitation of disturbed areas will reduce erosion hazard.

During construction, potential risk of erosion is high given the steep terrain and need to develop new access tracks resulting in soil disturbance during earthworks. The potential for erosion of soils is increased where access is required in steep areas. Heavy traffic use also has the potential to deteriorate road conditions and access to surrounding agricultural properties. Sediments eroded from soil material at higher elevations can be deposited in habitat zones and waterways further downslope, potentially impacting ecosystem functions of terrestrial vegetation communities and receiving waters. These areas have a cover of existing native vegetation providing some protection from rainfall events, however localised scour and soil movement is evident where native groundcover is absent.

Pre-construction activities and construction activities may impact water quality associated with erosion and sedimentation where groundcover removal will expose soils. Impacts during the construction phase will be temporary and impact relatively small areas (e.g., trenching), allowing for progressive rehabilitation (e.g., re-establishing groundcover) to minimise erosion and sedimentation risk as soon as possible. The more permanent areas of disturbance, including WTG foundations, roads, laydown areas, and substations will be designed and constructed to minimise erosion and runoff.

OPERATION

The operation phase is reasonably stationary regarding impact to soils, geology, and soil landscapes. Minimal works may be undertaken during this phase to support operations; any works undertaken would undergo the same level of attentiveness to designing construction and ESC measures according to soil landscapes. This phase includes day to day maintenance such as driving on existing tracks between areas of interest (WTG, substation etc.) and monitoring and is not expected to cause significant undue impacts to the Project site.

DECOMMISSIONING

The decommissioning phase, at the end of the life of the Project, would include the deconstruction of existing infrastructure and the rehabilitation of the impacted areas. The potential impacts during this phase are similar to the construction phase, with the main difference being less earthworks required as it will not be necessary to clear any pre-construction vegetation or new access tracks. Instead, the earthworks will reshape the landscape to compliment the original landscape – including the replacement of stored subsoil and topsoil. Subsurface infrastructure installed via trenching is expected to remain in-situ and therefore will not pose any further risk to the soil, soil landscape or geology.

The risks during this phase to the soil, soil landscapes and geology are similar to the construction phase. These include, but are not limited to earthworks reshaping, and erosion of bare earth – particularly when the stored soil is replaced during rehabilitation. The risks should be managed with care according to the soil landscapes with appropriate ESC measures.

With appropriate care and management, it is not expected that the Project will have a long-term impact to the existing landscape, and the landscape should be as functional post-decommissioning as it was pre-construction.

6.10.2.2. Salinity, Acid Sulphate Soils, Naturally Occurring Asbestos

CONSTRUCTION

Construction activities include excavation and land clearing, importation of soil, plant, and materials to site. Contamination may occur during these activities through unexpected contaminants being unearthed and disturbed during clearing and excavation and clearing. Servicing, refuelling and maintenance of equipment and plant may lead to spills and drips. Inadequate storage of oils, greases and other chemicals may also cause contamination of the Project Site.

Contaminated materials may be imported for use within the Project Site. Soil contamination may occur through importation of contaminated materials attached to equipment and the construction of underground cable trenches lined with aggregate, and gravels can create preferential pathways for contamination migration.

Fuels and lubricants and other chemicals will be used on site during construction activities and pose a potential risk of contamination to both surface and groundwater in the event of a spill. Contaminants in the soil may also be mobilised during rainfall events and may potentially enter nearby watercourses, potentially impacting surface water and groundwater quality for third party users.

Management of temporary sewage systems established onsite for the duration of the Project also pose a risk to surface water quality should spills occur.

OPERATION

During operation of the Project, potential contamination sources are from servicing of the turbines, heavy machinery, transformers and batteries on site, oils from the transformers on site and battery electrolytes. Storage of these materials will also be onsite. Potential impacts include leaks, drips, and spills of these materials.

Decommissioning of the Project Site will require use of heavy vehicles and machinery. Risks and types of contamination are likely to be similar to those in the construction phase.

Potential contamination sources are from servicing of the turbines, heavy machinery, transformers and batteries on site, oils from the transformers on site and battery electrolytes. Storage of these materials will also be onsite. Potential impacts include leaks, drips, and spills of these materials.

6.10.2.3. Air Quality and Emissions

The risk associated with dust emissions from construction is related to:

- The type of activity being undertaken (number of vehicles and plant)
- Duration of activities
- Size of the Project Site
- Meteorological conditions
- Proximity to receptors; and
- Adequacy of the mitigation measures and sensitivity of the receptors

Most potential impacts to air quality will occur during the construction phase of the Project, when the key pollutant of concern will be dust particles TSP, PM_{10} and $PM_{2.5}$. Potential sources of air pollution are listed below during both the construction and operational phases:

- Construction
  - Clearing of vegetation
  - Excavation works for construction of infrastructure
  - Drilling and blasting material
  - Conveying material
  - Transferring material to stockpiles
  - Stockpiling material
  - Loading hoppers
  - Loading trucks with material
  - Unloading trucks at location
  - Use of front-end-loaders and other construction equipment

  - Hauling and vehicles on unsealed access tracks

- Operation
  - Wind erosion of exposed areas
  - Use of project operational equipment
  - Vehicles on unsealed access tracks
  - Maintenance works on infrastructure incl. access tracks, hardstands and laydown areas

CALMET ASSESSMENT

A year of meteorological data for 2018 was obtained and input into the CALPUFF dispersion modelling program used to simulate the effects of time and space varying meteorological conditions on the transportation, transformation and removal of pollution and can be applied to large geographic areas. The data is considered sufficiently representative of the wind climate at the Project Site and study region in general. The study region used for the assessment was 48 km x 48 km with a grid spacing of 1 km to allow the capture of terrain effects. The model was used to assess the emissions from road sources with conservative assumptions made when calculating pollutant emission rates.

Background levels were selected from 2018 local air quality data for consistency with the met data provided by the BoM station. Background levels are combined with predicted incremental impacts from modelling to assess the cumulative impact for compliance with the criteria. The background levels of both $PM_{2.5}$ and PM_{10} for the Project Site were taken to assist in determining the cumulative effect the Project would have on particulate emissions. The *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (2022)* sets out the criteria of compliant levels of $PM_{2.5}$ and PM_{10} within proximity to a sensitive receptor. The AQIA modelled the highest predicted pollutant concentrations at 58 sensitive receptor locations for the operation of the WTGs. A brief summary of the results is presented in Table 6-84, with greater detail provided in the Air Quality Assessment (Benbow, 2023; Appendix O). The summary shows that prior to any potential particulate impacts of the Project, the background 24-hour average of both $PM_{2.5}$ and PM_{10} is above the criteria set out in the *Approved Methods*, while the annual average for both is well below the approved average. When factoring the incremental impact on individual receivers for both $PM_{2.5}$ and PM_{10}, the compliance rating remains the same. That is to say the 24-hour average was not compliant as a result of elevated background levels, while the annual average was compliant. Furthermore, the estimated impact results for TSP at all 58 receivers was well below the compliance threshold of 90 µg/m^3. The background TSP level was measured as 36.8 µg/m^3 with no receiver expected to experience an impact greater than 39 µg/m^3 inclusive of Project related impacts. This demonstrates the limited impact of the Project on Total Suspended Particles on individual receivers.

Table 6-84: Daily and annual background levels of PM 2.5 and PM10 within Project Site (Benbow, 2023)

Receptor ID	24 Hour Average			Annual Average		
	Background (µg/m³)	Criteria (µg/m³)	Compliant (Yes/No)	Background (µg/m³)	Criteria (µg/m³)	Compliant (Yes/No)
PM 2.5 Particles						
All	40.5 µg/m³	25 µg/m³	No	7 µg/m³	8 µg/m³	Yes
PM 10 Particles						
All	274.1 µg/m³	50 µg/m³	No	18.8 µg/m³	25 µg/m³	Yes
Total Suspended Particulates (TSP) – Annual Average						
All	-	-	-	36.8	90	Yes

Due to the high background dust levels of $PM_{2.5}$ and PM_{10} at the Project Site, the *Approved Methods* (EPA, 2022) require a demonstration that no additional exceedances of the impact assessment criteria will occur because of the proposed activities. Benbow Environmental (2023; Appendix O) assessed the contemporaneous impact and background of the top days of highest background concentrations and the top days of highest predicted increments of $PM_{2.5}$ and PM_{10} for dwelling R1. When observing the highest background emissions and the highest incremental emissions at dwelling R1, most of the year met the cumulative threshold of 25 µg/m^3 and 50 µg/m^3 for $PM_{2.5}$ and PM_{10} respectively.

A single exceedance of PM_{10} on the impact assessment criteria is predicted to occur because of the emissions from the Project. As a background concentration for the instance of exceedance is very close to the criteria at 49.7 µg/m^3, with the criteria of 50 µg/m^3, the impact due to emissions from the Project is anticipated to be minimal, with the exceedance almost entirely attributed to background PM_{10} emissions. As a result, the design installation, and operation of the Project is not anticipated to affect the air quality of the surrounding area.

GREENHOUSE GAS EMISSIONS

The development of the Project, as with any infrastructure development, will produce direct and indirect greenhouse gas (GHG) emissions that are related to both the construction and operation of the Project. The benefit of the development of the Project is that while the construction phase will result in the largest portion of emissions relative to the Project, overall, the Project will produce significantly lower emissions than other forms of energy generation. The operational activities that would generate direct GHG emissions will be from the use of liquid fuel in plant. Indirect GHG emissions include the use of electricity.

The *National Greenhouse and Energy Reporting Act 2007* (NGER Act) provides emissions thresholds related to the reporting requirements for facilities, with the threshold for $CO_{2\text{-}e}$ of 25 kt (scope 1 and 2 emissions) or more requiring reporting. Emissions are commonly classified as direct or indirect emissions, which are defined by the GHG Protocol as:

- **Direct Emissions:** Emissions from sources within the boundary of an organisation and because of that organisations activities (Scope 1 emissions).
- **Indirect Emissions:** Emissions generated in the wider economy that are a consequence of the activities of the organisation but occur at sources owned or controlled by another entity.

Scope 1 emissions from the Project would be generated from operational activities. The following activities are likely to contribute to Scope 1 emissions:

- Fuel consumption per vehicle (7.7 L/100 km).
- Operational requirements (including scheduled and unscheduled maintenance generating approximately 5 trips per day on the local road network).
- Maintenance travel by vehicle of 475.65 km per day.
- Maintenance vehicles to use 13.37 kilolitres of diesel per year.
- Project operating 365 days per year.

Scope 2 emissions generated from the Project may include:

- Consumption of electricity for the running of the facility (estimated 500,000 kWh per year)

Table 6-85 outlines the calculated GHG emissions for Scope 1 and 2 emissions of the Project.

Table 6-85: Greenhouse Gas Emissions calculations for scope 1 and 2 emissions of the Project (Benbow Environmental, 2023)

Emissions Scope	Source	Energy Use	Kg CO_{2-e}		
			CO_2	CH_4	N_2O
Scope 1	Diesel Oil	516 GJ	36,069	51.7	103.2
Scope 2	Electricity	500,000 kWh	365,000	-	-

The total kilotons (kT) of GHG emissions for Scope 1 and Scope 2 emissions are 0.036 kT and 0.365 kT respectively. Based on these predicted emissions, the Project will not trigger the presented reporting requirements to NGER as they are below the threshold set in the NGER Act.

6.10.2.4. Land Use and Agricultural Land

LOSS OF AGRICULTURAL LAND AND PRODUCTION

The agricultural impacts from the construction and operation of the Project will result in some loss of land from the installation and operation of infrastructure. Disturbance will be more prevalent during construction resulting in grazing area unavailable for agricultural production for the duration of the operational lifetime.

The estimated direct disturbance area over agricultural land from the Project is approximately 855 ha Development Footprint, inclusive of the 74-ha required for external road upgrades. This area will permanently be removed from agricultural land or impacted for the duration of the Project. It is noted that the estimated direct disturbance area includes transmission lines that will not prevent the continuation of agricultural activities, largely grazing, from occurring underneath (161 ha). Additionally:

- Road upgrades for the external transport route (74 ha) include the footprint of the existing road, and therefore impacts are expected to remove negligible existing or additional agricultural land.
- Some benefit is likely from the development of improved access roads and tracks associated with the Project which will provide improved access to surrounding properties. -
- Landholders with WTGs in LSC 7 will benefit by better access to muster and control feral animals and weeds.

Loss of grazing and cropping agricultural production is expected to be minimal due to small areas being removed from production by the Development Footprint. The impact of the WTGs and transmission corridors should not impact on agricultural production. The general losses across the balance of the Project Site (beyond the Development Footprint) are expected to be negligible given any potential Project impacts on wider operations can be mitigated through measures on farms.

No land within the Development Footprint is deemed viable long term cropping land. There are no cropping systems directly affected by the Project. Therefore, no economic loss is expected to occur to cropping agricultural production directly from the development of the Project infrastructure.

Livestock production potential for affected areas have been estimated based on site observation of land capability, regional averages, and current livestock numbers with discussions with potentially impacted landowners. This is reflective of average stocking rates in the local region with alike agricultural capability in terms of soils and rainfall. The livestock enterprises present and average DSE values have been used to calculate the estimated total gross income loss and are summarised in Table 6-86 below in July 2023.

Table 6-86: Livestock Enterprises (as of July 2023)

Project Element	Enterprise Present	DSE Value	$/ha
Northern Transmission Line	Self-Replacing Merino ewes	$331.14	$311.40
	Agistment Cows	$7.87	$7.55
Southern Transmission Line	Merino wether	$41.57	$31.64
	Cattle Breeding	$28.34	$25.00
Wind Farm	Meat Sheep	$58.78	$81.42
	Cattle Breeding	$39.67	$275.00

The loss of income from the removal of 781 ha from agricultural land is estimated to be $139,020. As the direct financial loss for each affected landholder is minimal, it is expected that the net financial outcome for landholders will be beneficial and more than compensate the loss.

BIOSECURITY & WEEDS

Biosecurity is a significant concern to the agricultural industry and breaches can result in the subsequent introduction or spreading of weeds, pests, disease, and pathogens. This can have a significant impact on the economic value of individual properties, the ability to manage production and marketability of product. The impacts and risk of potential biosecurity impacts are higher during the construction phase, compared to that of the operation as it is directly linked the intensity of construction activities and increase volume of machinery, equipment, vehicles, and personnel.

Hypericum perforatum (St John's Wort) and Blue Heliotrope (*Heliotropium amplexicaule*) are high risk high risk weeds, as they are present on many properties within the Development Footprint, becoming well established at some properties. St John's Wort can compete with pastures, poison livestock, and negatively impact animal health, downgrade wool products and reduce property value (NSW WeedWise, 2023). St John's Wort spreads through sticky seed capsules that stick to animals or clothing and can be carried in the digestive tracts of animals. Wind can also spread seed over short distances. Water, machinery, humans, livestock, and feral animals can spread seed over long distances. During Project construction, operation and decommission, the movement of equipment, vehicles, machinery, or personnel increases the risk that weeds could be introduced or transferred between properties.

LIVESTOCK MANAGEMENT

During construction and operation, there is a risk of livestock escaping where protocols are not in place to ensure gates are always left closed. Noise from construction activity can also impact ewes during the lambing season which could lead to losses, especially during the construction phase when site activity is highest. The possibility of damage to fences and other livestock infrastructure, and gates being left open are lower during the operational phase.

IMPACTS TO ADJACENT LAND

Consultation has been focused on directly affected landowners where land title immediately surrounds or is located within the Project Site. Neighbouring landowners outside the Project Site and other stakeholders have been involved in community consultation through telephone calls, emails, dedicated meetings, and a feedback form.

Key risks that could impact adjacent landowners include the biosecurity hazards associated with the spreading of weeds (e.g., St John's Wort) during construction, escapee livestock and soil erosion/deposition from the Project Site in steeper erosion prone areas. Therefore, mitigation measures must be in place to manage these risks through groundcover and road construction design and monitoring. Other potential impacts to adjacent land highlighted by landowners from consultation include:

- Visual and noise impacts
- Property values
- Road design, dust, and transport times

To assess potential agricultural impacts on neighbouring properties, the LUCRA system is utilised to identify and assess the potential for land use conflict to occur between neighbouring land uses and assessing the possibility for, and potential level of, future land use conflict.

LAND USE CONFLICT

The LUCRA process uses a risk ranking matrix to rank identified potential land use conflicts and assess the environmental, public health and amenity impacts based on the probability of occurrence and the consequences of the impact. Table 6-87 outlines the risk matrix with a risk ranking of 25 to 1, with 25 being the highest magnitude of risk, being highly likely and very serious. Conversely a risk ranking of 1 indicates the lowest magnitude of risk or is almost impossible with very little consequence.

Table 6-87: LUCRA risk rating matrix and measure of consequence (DPI, 2011)

Consequence	Probability	A	B	C	D	E
1		25	24	22	19	15
2		23	21	18	14	10
3		20	17	13	9	6
4		16	12	8	5	3
5		11	7	4	2	1

Measure of Consequence		
1	Severe	• Severe and/or permanent damage to the environment • Irreversible • Severe impact on the community • Neighbours are in prolonged dispute and legal action involved
2	Major	• Serious and/or long-term impact to the environment • Long-term management implications • Serious impact on the community • Neighbours are in serious dispute
3	Moderate	• Moderate and/or medium-term impact to the environment and community • Some ongoing management implications • Neighbour disputes occur
4	Minor	• Minor and/or short-term impact to the environment and community • Can be effectively managed as part of normal operations • Infrequent disputes between neighbours
5	Negligible	• Very minor impact to the environment and community • Can be effectively managed as part of normal operations • Neighbour disputes unlikely

The potential sources of conflict that may occur from the Project are presented in Table 6-88. The initial risk evaluation for each activity relevant to the Project has been identified and evaluated for their initial risk for potential conflict prior to management measures being implemented.

Table 6-88: Initial risk evaluation (unmitigated) (Tucker Environmental, 2023)

Phase	Identified Potential Conflict	Risk Ranking
Construction	Dust – generated from machinery affecting human or animal health and viability of grazing in the area	9
	Noise – exceedance of noise generated from machinery on a frequent basis disturbing human and animal amenity.	13
	Erosion, scour & sediments – erosion or sediment run-off from soil disturbance during construction of access road and infrastructure, especially in areas with steep topography potentially impacting downstream water quality.	17
	Biosecurity – spreading of weeds, disease or pests on project site or surrounding properties.	18

Phase	Identified Potential Conflict	Risk Ranking
	Contamination/sedimentation of watercourses – runoff potentially impacting downstream water sources and quality and overall livestock health.	13
	Traffic – increased traffic in local area could affect safety of residents, livestock and other vehicles and could damage existing roads from heavy traffic.	14
	Livestock management – animals could escape or become trapped if gates are not closed by contractors.	8
Operation	Agricultural productivity - reduced agricultural productivity in the region by removing the extent of land available for grazing.	8

6.10.3. Mitigation Measures

Table 6-89 outlines the proposed measures to mitigate potential Soils, Land Use and Agricultural Land impacts.

Table 6-89: Mitigation Measures for Soils, Land Use and Agricultural Land

Environmental Impact	Mitigation Measure	Reference Code
Erosion and Sedimentation	Prepare an Erosion and Sedimentation Management Plan (ESMP) in accordance with the *Blue Book – Managing Urban Stormwater: Soils and Construction* (Landcom, 2004). The ESMP must include: • Site constraints and receiving water. • Stockpile management. • Temporary site stabilisation and progressive revegetation. • Management measures for disturbance of sodic soils. • Separation of clean and dirty water. • Progressive erosion and sediment controls drawings prepared by a Certified Professional in Erosion and Sediment Control. • An inspection, monitoring and maintenance schedule.	ES001
	Establish no-go areas to minimise ground cover disturbance and protect environmentally sensitive areas.	ES002
	Do not build crossings and trenches on watercourse bends or meanders to reduce the chance of exacerbating erosion in these areas.	ES003
	Design lay down areas for each WTG location to minimise disturbance.	ES004
	During decommissioning, ensure earthworks undertaken to reshape the landscape compliment the original landscape including the replacement of stored subsoil and topsoil. Where surface levels are altered by the removal of subsurface infrastructure, stored topsoil shall be used for leveling.	ES005
	Restore areas subject to temporary construction impacts (construction compounds and laydown areas) to original condition through vegetation of groundcover to minimise erosion.	ES006
Soil Contamination and Disturbance of Naturally Occurring Asbestos	For any excess spoil material which requires offsite disposal, formally classify waste before being taken to an appropriately licensed landfill in accordance with the EPA (2014) *Waste Classification Guidelines*.	CT001
	Establish a site compound to store all chemicals (e.g., fuel, oil) in appropriate bunding/storage systems within the approved storage facility. Locate equipment washdown areas nearby and contain and dispose of wastewater appropriately.	CT002

Environmental Impact	Mitigation Measure	Reference Code
	Store dangerous and hazardous materials on site in accordance with *AS1940-2004: The storage and handling of flammable and combustible liquids.*	CT003
	Ensure the concrete batching plant is suitably bunded.	CT004
	Ensure appropriate spill kits are carried will all equipment.	CT005
	Develop an unexpected finds protocol for the Project and include during site inductions to ensure that any unexpected contamination is identified, assessed, and managed appropriately.	CT006
	Secure Project Site to minimise access and illegal dumping of waste and contaminated materials.	CT007
	Implement active and preventative dust suppression controls in the case that serpentine minerals are observed to ensure airborne particulate matter generated during construction activities are either minimised or contained. Note, the below measures are for dust and particulate matter if NOA is suspected by encountering serpentine minerals and includes: • Immediately cease all dust generating activities during high wind conditions or where airborne dust is visible. • Use of water sprays during dust generating activities (excavations, drilling, earthworks, etc.). • Use of water sprays on disturbed surfaces and uncovered stockpiled materials. • Spraying unsealed haulage roadways with the use of a water cart. • Reducing on-site vehicle speeds on unsealed roadways. • Covering and/or containing (2-3 walls) excavated materials. • Covering outgoing loads of excavated materials.	CT008
	Should serpentine minerals or potential NOA be encountered, appropriate decontamination of equipment and personnel will be conducted at the end of each working day.	CT009
	Thoroughly decontaminate potential NOA contaminated equipment and any collected materials should be transferred to a dedicated receptacle labelled “POTENTIALLY CONTAINS ASBESTOS”.	CT010
	Establish dedicated refuelling areas outside environmentally sensitive areas and away from creek lines. These areas are to be bunded to ensure any spills do not enter these sensitive areas.	CT0011
Air Quality and Emissions	The generation of dust is of concern during construction. The following measures and requirements should be followed for the life of the Project to minimise dust generated by the Project: • Watering of unsealed roads. • Trucks entering and exiting site to be well maintained in accordance with manufacturer specifications to comply with relevant regulations. Fines may be imposed on vehicles that do not comply with smoke emissions standards. Truck movement should be controlled on site and restricted to designated roadways. • Truck wheel washes or other dust removal procedures to be installed to minimise transport of dust off site. • If necessary, suspend construction activities during periods of high winds and covering/watering/revegetating stockpiles and exposed areas.	AQ001

Environmental Impact	Mitigation Measure	Reference Code
	Dust and similar emissions from construction operations and on-site equipment should be mitigated through the following procedures: • All equipment used and facilities erected are designed and operated to control the emission of smoke, dust, fume, and other objectionable matter into the atmosphere. • Spray earthworks, roads, and other surfaces as necessary with water or other suitable liquids as a form of dust suppression for onsite materials, sealing of temporary haul roads and the modification of operations during high or unfavourable wind conditions. • Working areas and access roads to be stabilised as soon as practicable to prevent or minimise wind-blown dust. • Stabilise all disturbed areas as soon as practicable to prevent or minimise wind-blown dust. • All unsealed roads to be kept sufficiently damp during working hours to minimise wind-blown or traffic generated dust emissions. • Water sprays, sprinklers and water carts may be employed if needed to dampen stockpiles, work areas and exposed soils to prevent dust emissions. • Maintain stockpiles and handling areas in a condition which minimises wind-blow or traffic generated dust. • Maintain dust control equipment in good operating condition. Construction equipment will be properly maintained to ensure exhaust emissions comply with the POEO Act. • If visible smoke can be seen from any equipment (while working on a construction site) for longer than 10 seconds, the equipment will be taken out of service and repaired or tuned so that smoke is no longer visible for periods longer than 10 second. • Cleared vegetation, demolition materials and other combustible waste materials will not be burnt on site. • Silt will be removed from behind filter fences and other erosion control structures on a regular basis. • No dust, soil or mud is to be deposited from any vehicle on public roads. Vehicles are to utilise wheel wash facilities prior to leaving the works area where provided. • Any dust, soil or mud deposited on public roads by subcontractors construction activities and vehicle movements shall be removed immediately and disposed of appropriately. • Hire agreements will contain provisions to stand down equipment which has excessively smoky exhaust.	AQ002
	To control air pollution specifically during construction activities, the below measures should be followed: • Watering and sealing of roads where possible. • Wind breaks composed of earth banks to protect areas by reducing capacity of wind to raise dust. • Maintain construction vehicles in accordance with manufacturer specifications and relevant regulations. • Progressive rehabilitation of exposed sites on completion of different work stages should be undertaken where practical.	AQ003

Environmental Impact	Mitigation Measure	Reference Code
	When winds reach (or exceed) a velocity of 2.5 m per second, the frequency of water used on exposed surfaces should increase. When winds exceed 10 m/s for 10 minutes, work should cease.	AQ04
	To reduce impacts of spoil stockpiles, the following measures should be undertaken: • Minimise spoil stockpiling on site. • Minimise the number of work faces on stockpiles. • Stockpiles to be temporarily covered (if short term) or sprayed with water/crusting agent (Polo Dust Bind) (long term) to keep dust to minimum. Cease all dust generating activities when conditions are excessively dusty such that the Project air quality goals are anticipated to be exceeded.	AQ005
	General mitigation measures to reduce emissions and improve air quality include: • Sites and surrounding public roads to be cleaned as required, with street sweepers. • No material to be burnt on site. • Silt and other materials to be removed from around erosion control structures following a significant rain event (>10 mm) to ensure deposits do not become dust source. • Water spraying to occur during loading of trucks, as required. • Visual monitoring to be undertaken by the Site Manager to assess the impacts of dust generation on air quality. If water spraying is not sufficient in controlling dust generated by construction works, a review of works considering dust monitoring results would be undertaken in accordance with the *Approved Methods* criteria. • During work on siliceous materials, if visual dust is observed, additional water sprays will be used at the workface to suppress dust. This will include the use of handheld hoses.	AQ006
	Where air quality monitoring identifies non-compliance with the relevant criteria, the Site Manage will plan and carry out corrective action. If monitoring indicates that the air quality objectives are being significantly exceeded on multiple occasions, the Site Manager will: • Identify the activities that were occurring at the time of the exceedance. • Determine the activities that were most likely contributing to the exceedance (employing continuous monitoring techniques outlined in the Air Quality Impact Assessment (Benbow, 2023; Appendix O). • Review construction process and environmental controls in place for this activity. • Implement an agreed alternative to control dust generation more adequately.	AQ0007
Agricultural Land	Develop a project-wide and property-specific Biosecurity Management Plan to guide protocols during construction and prevent the introduction and spread of potentially irreversible spread of weeds, pests, pathogens, and diseases. This should include: • Protocols that are practical for that property to be agreed with landowner and contractors (e.g., vehicle and footwear hygiene practices).	AG001

Environmental Impact	Mitigation Measure	Reference Code
	• Reference to the Central Tablelands Regional Strategic Weed Management plan 2023-2027 and the Central West Regional Strategic Weed Management Plan 2023-2027.	
	Develop a weed management strategy that spells out the extent of St. John's Wort and strategies to minimise movement of seed on vehicles and avoid spreading from properties with it, to those without it. This weed is considered a high priority for asset protection under regional management plans.	AG002
	Introduce protocols during construction to ensure internal gates are always closed to avoid the escape, trapping of livestock.	AG003
	Develop a Decommissioning Management Plan that will have an objective of returning the land capability to its pre-existing agricultural capacity. Rehabilitate soil and vegetation to ensure soil profiles are reinstated and pasture/vegetation to ensure agricultural production can continue pre-construction levels.	AG004

6.11

Surface Water, Groundwater, and Aquatic Ecosystems

A Surface Water Impact Assessment (ELA, 2023d, Appendix Q) and Groundwater Impact Assessment (ELAe, 2023, Appendix R) have been prepared. The assessments have been prepared in accordance with the requirements of the SEARs, which include:

- *Quantify water demand, identify water sources (surface and groundwater), including any licensing requirements, and determine whether an adequate and secure water supply is available for the development;*
- *Assess the likely impacts of the development (including flooding) on surface water and groundwater resources traversing the site and surrounding watercourses (including their Strahler Stream Order), drainage channels, wetlands, riparian land, farm dams, groundwater dependent ecosystems and acid sulfate soils, related infrastructure, adjacent licensed water users and basic landholder rights, and measures proposed to monitor, reduce, and mitigate these impacts;*
- *Where the project involves works within 40 metres of the high bank of any river, lake, or the*

waterfront land (collectively waterfront land), identify likely impacts to the waterfront land, and how the activities are to be designed and implemented in accordance with the DPI Guidelines for Controlled Activities on Waterfront Land (2018) and (if necessary) Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (DPI 2003); and Policy & Guidelines for Fish Habitat Conservation & Management (DPI, 2013);

- *Describe the measures to minimise surface and groundwater impacts, including how works on steep gradient land or erodible soil types would be managed and any contingency requirements to address residual impacts in accordance with the Managing Urban Stormwater: Soils and Construction series of guidelines; and*
- *Assess the risks of dust generation and proposed mitigation measures designed in accordance with the Approved Methods and Guidelines for the Modelling and Assessment of Air Pollutants in New South Wales (DECC, 2005)*

Assessment Overview

The Surface Water Impact Assessment, Groundwater Impact Assessment and Flooding Impact Assessment were undertaken by ELA to determine the potential impacts of the Project on a range of water-based factors. This includes impacts to:

- The regional catchment
- Surface water and hydrology (water quantity and quality) and surface water contamination
- Riparian land and aquatic ecosystems
- Groundwater
    - water tables and recharge zones
    - groundwater dependent ecosystems
    - groundwater contamination
    - aquifer interference
- Flooding potential in watercourses

The Project will require increased water consumption during the construction phase from groundwater supplies. However, the supply will be limited as water will be sourced locally where practical or through suppliers.

The construction of WTGs has the potential to impact aquatic ecosystems both directly and indirectly. A number of measures can be taken to avoid and minimise potential impact, including construction on or near waterways during periods of no water flow and locating WTGs on elevated ridgelines, away from watercourses.

The Groundwater Impact Assessment determined the potential for WTGs to intercept groundwater to be highly unlikely due to the placement and construction of Project infrastructure on ridgelines, away from watercourses.

Threatened fish species were assessed as having the potential to occur in some waterways within the Project Site, including Type 2 and Type 3 aquatic Groundwater Dependent Ecosystems. Utilising groundwater data, the assessment further determined that the potential to occur would be unlikely.

Mitigation measures have been proposed for potential impacts of the Project in Section 6.11.3

6.11.1. Existing Environment

6.11.1.1. Regional Catchment, Surface Water and Hydrology

REGIONAL CATCHMENT

The Project Site is located within the Macquarie-Bogan River Catchment and drains into Lake Burrendong. The Cudgegong River and Macquarie River form tributaries to the lake at the north-western and south-eastern extents of the lake, respectively. Burrendong Dam is the largest storage in the Macquarie catchment, capable of storing 1,190 GL and was built in 1967 (MDBA 2021).

The main watercourses within and adjacent to the Project Site are the Macquarie River to the west, with the Cudgegong River flowing near the northern extent of the Project Site. There are numerous watercourses of varying size, ranging from 1st to 9th order (Strahler system) within the Project Site, including Little Oaky Creek, Gundowda Creek, Black Willow Creek, Long Gully, Sheas Creek, Redbank Creek, Oaky Creak, Macquarie River and Cudgegong River. The location of these streams in relation to the proposed Project site for the Project, powerline easement and road upgrades are shown in Figure 6-58. The streams within the Project Site are in varying conditions, with lower order streams mostly ephemeral and only flow after heavy rain.

The Project Site is located within the Burrendong Dam Tributaries Water Source and surface water is managed in accordance with the Water Sharing Plan for the Macquarie Bogan Unregulated and Alluvial Water Sources 2012.

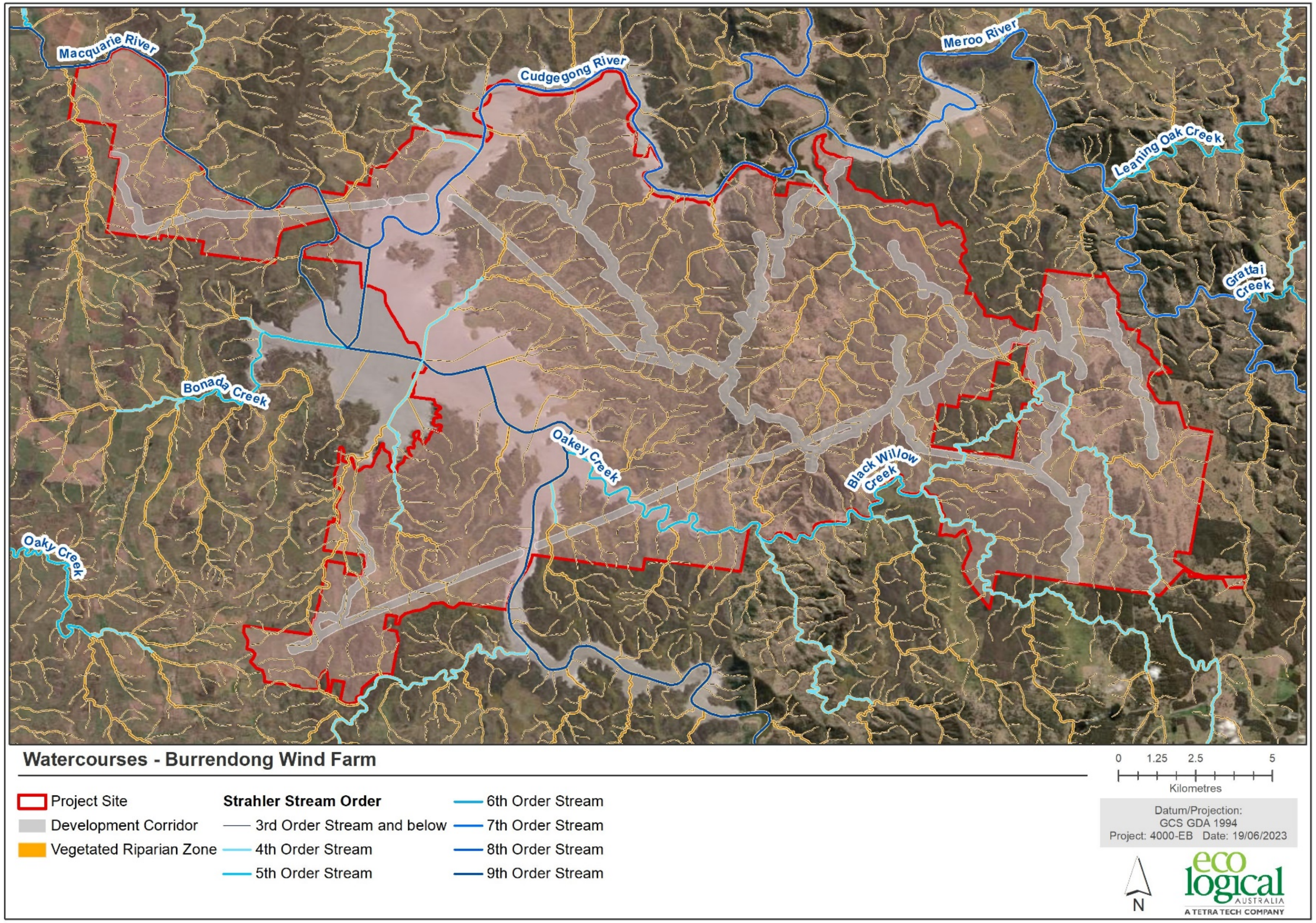


Figure 6-58: Strahler Order Watercourses within the Project Site

SURFACE WATER AND HYDROLOGY

Watercourses in the north of the Project Site flow into the Cudgegong River, while in the east and south of the Project Site, watercourses flow into the Macquarie River and Burrendong Dam.

A field survey was carried out by two aquatic ecologists in March 2021 to develop a representative picture of the condition of watercourses within the Project Site. Due to the size of the Project Site and the inability to access all watercourses, focus areas for inspection were chosen prior to the survey by identifying areas likely to be directly impacted by the Project, areas mapped as having potential to support threatened aquatic fauna and a range of Strahler order streams.

The condition of streams within the Project Site varied, often dictated by the surrounding land use.

Some 1st order streams, such as Redbank Creek in the east of the Project Site, were well-defined with wide but shallow channels that had no evidence of aquatic macrophytes or standing water and were up to 8 m wide (Figure 6-59). Other 1st order streams like Bulls Pound Gully towards the west of the Project Site were narrow, steep gullies with channels up to 1 m wide (Figure 6-59).

Figure 6-59: Redbank Creek, a 1st order stream, looking downstream (left) and Bulls Pound Gully, a 1st order stream, looking upstream (right)

Several informal ford crossings already exist within the Project Site. The crossing over Little Oaky Creek, a 4th order watercourse, showed evidence of vehicles crossing the stream causing turbidity within the watercourse (Figure 6-60), which was a cobble-dominated stream with slow flowing water and deep pools but lacked aquatic macrophytes (Figure 6-60).

Towards the western edge of the Project Site, a vehicle crossing over Oaky Creek, a 5th order stream, was observed. The creek was running at the time of the field survey and aquatic macrophytes were observed on the banks and within the stream (Figure 6-60).

Figure 6-60: Informal road crossing over Little Oaky Creek, a 4th order stream (top left); Little Oaky Creek, downstream of vehicle crossing, looking downstream (top right); and informal road crossing over Oaky Creek, a 5th order stream (bottom)

Some watercourses within the Project Site were quite degraded with bank erosion and poor water quality. These occurred in areas where the surrounding land was grazed and the only vegetation in the riparian zone was herbaceous groundcovers. Highland Home Creek, a 2nd order watercourse located at the eastern extent of the Project Site, was an incised, relatively narrow creek line with severe slumping of the bank (Figure 6-61). Devils Hole Creek, a 2nd order watercourse in the west of the Project Site, was also quite degraded, with steep banks up to 4 m high in areas and active erosion observed (Figure 6-61).

Figure 6-61: Highland Home Creek, a 2nd order stream, looking upstream (left) and Devils Hole Creek, a 2nd order stream, looking upstream (right)

6.11.1.2. Riparian Land and Aquatic Ecosystems

Most of the riparian corridors within the Project Site were relatively degraded, having been cleared for agriculture. Where vegetated riparian corridors were in place, they were often narrow and missing a vegetation layer. Where vegetation had been cleared to the top of the bank, bank erosion and proliferation of weed species were often observed.

NRAR's Guidelines for Controlled Activities on waterfront land—Riparian corridors (NRAR 2018) outlines the need for a Vegetated Riparian Zone (VRZ) adjacent to the channel to provide a transition zone between the terrestrial environment and watercourse. This vegetated zone helps maintain and improve the ecological functions of a watercourse whilst providing habitat for terrestrial flora and fauna. The VRZ plus the channel (bed and banks of the watercourse to the highest bank) constitute the 'riparian corridor'. NRAR recommends generic VRZ widths based on watercourse order as classified under the Strahler System of ordering watercourses and using Hydroline Spatial Data which is published on the department's website (Table 6-90).

Table 6-90: Recommended riparian corridor widths relative to Strahler order (NRAR 2018)

Watercourse type	VRZ width (each side of watercourse)	Total riparian corridor width
1st order	10 m	20 m + channel width
2nd order	20 m	40 m + channel width
3rd order	30 m	60 m + channel width
4th order and greater*	40 m	80 m + channel width

includes estuaries, wetlands and any parts of rivers influenced by tidal waters

Non-riparian uses may be authorised by NRAR within the outer 50% of the VRZ, as long as compensation (1:1 offset) is achieved within the Project Site. The outer VRZ that is impacted shall be offset elsewhere on-site using the 'averaging rule'. Stream realignment is permissible for 1st order streams only unless a merit-assessment is undertaken and endorsed by NRAR. Any road crossing type is permissible across a 1st or 2nd order stream, whereas bridges and culverts are preferred when crossing 3rd order or higher streams.

VRZs for watercourses within the site have been mapped in Figure 6-62 . As the Project is classified as SSD, a water management work approval under section 90, or an activity approval under section 91 of the WM Act is not required where the development consent for the SSD authorises the carrying out of those works. Accordingly, the controlled activities undertaken within VRZs (e.g., road crossings and installation of cables) will be undertaken with reference to NRAR guidelines. Except for crossings, all construction works should be positioned outside of the VRZ width for its corresponding stream order.

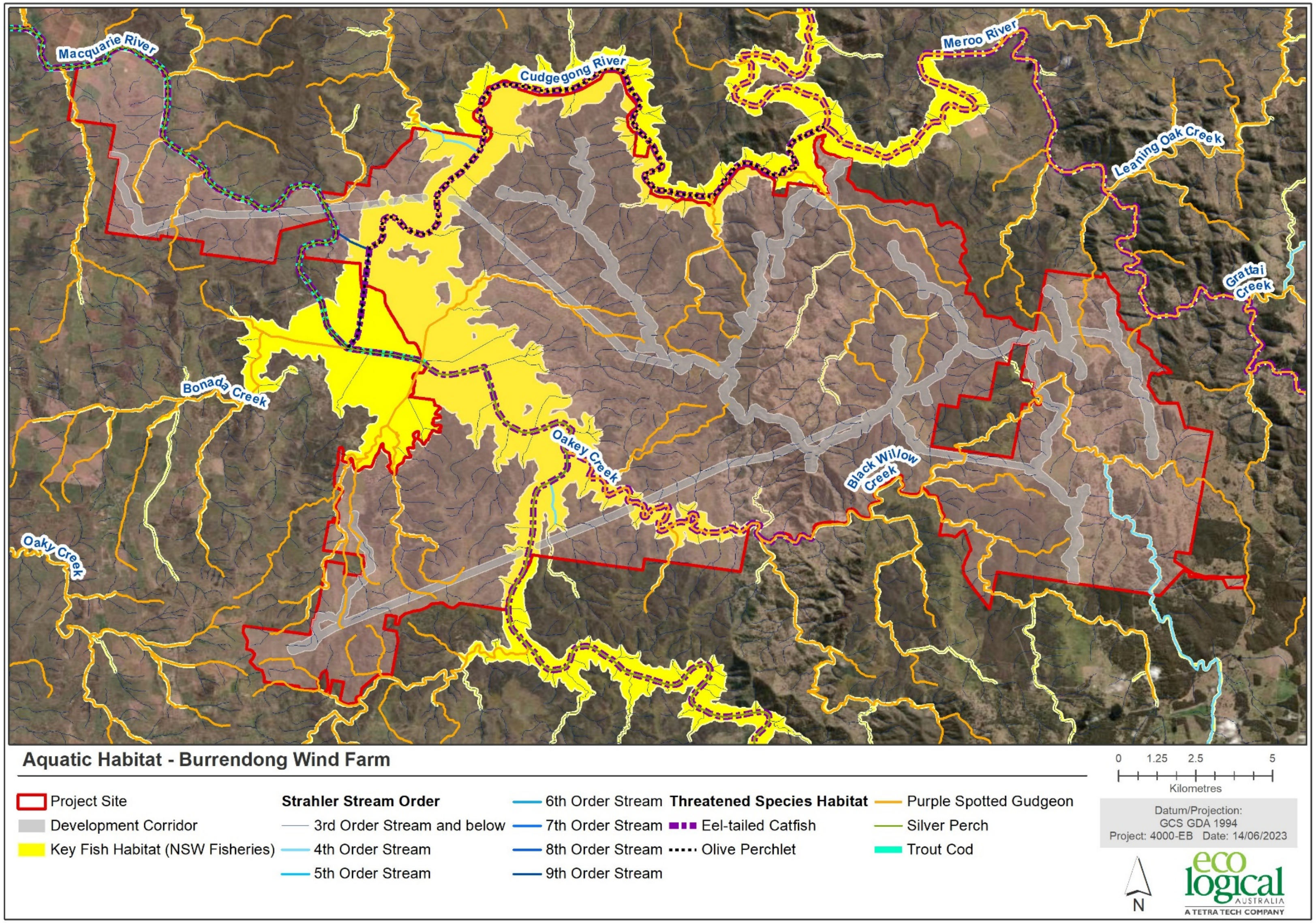


Figure 6-62: Vegetated Riparian Zones, Key Fish Habitat and aquatic habitat within the Project Site

KEY FISH HABITAT

DPI Fisheries identifies areas of KFH within NSW. These are areas that are important to the maintenance of fish populations and to the survival and recovery of threatened species. Several waterways within the Project Site have been identified by DPI Fisheries as KFH and these are shown in Figure 6-62 above.

The Policy and guidelines for fish habitat conservation and management (Fairfull 2013) is a supplementary document that outlines the requirements and obligations under the FM Act and the Fisheries Management (General) Regulation 2010 and was developed to maintain and enhance fish habitat and assist in the protection of threatened species. The Policy defines the type of KFH (Table 6-91) and provides guidance for assigning a rating for fish habitat sensitivity (Table 6-92) and is applied as relevant in the current assessment. The Policy also provides guidance for recommended watercourse crossing types based on KFH types and class (Table 6-93).

Table 6-91: KFH and associated sensitivity classification scheme (Fairfull 2013)

KFH and associated sensitivity classification scheme (for assessing potential impacts of certain activities and developments on key fish habitat types)
TYPE 1 – Highly sensitive KFH:
Posidonia australis (strapweed)
Zostera, Heterozostera, Halophila and *Ruppia* species of seagrass beds >5 m2 in area
Coastal saltmarsh >5 m2 in area
Coral communities
Coastal lakes and lagoons that have a natural opening and closing regime (i.e. are not permanently open or artificially opened or are subject to one off unauthorised openings)
Marine park, an aquatic reserve or intertidal protected area
SEPP 14 coastal wetlands, wetlands recognised under international agreements (e.g. Ramsar, JAMBA, CAMBA, ROKAMBA wetlands), wetlands listed in the Directory of Important Wetlands of Australia
Freshwater habitats that contain in-stream gravel beds, rocks greater than 500 mm in two dimensions, snags greater than 300 mm in diameter or 3 metres in length, or native aquatic plants
Any known or expected protected or threatened species habitat or area of declared 'critical habitat' under the FM Act
Mound springs
TYPE 2 – Moderately sensitive KFH:
Zostera, Heterozostera, Halophila and *Ruppia* species of seagrass beds <5 m2 in area
Mangroves
Coastal saltmarsh <5 m2 in area
Marine macroalgae such as *Ecklonia* and *Sargassum* species
Estuarine and marine rocky reefs
Coastal lakes and lagoons that are permanently open or subject to artificial opening via agreed management arrangements (e.g. managed in line with an entrance management program)
Aquatic habitat within 100 m of a marine park, an aquatic reserve or intertidal protected area
Stable intertidal sand/mud flats, coastal and estuarine sandy beaches with large populations of in-fauna

KFH and associated sensitivity classification scheme (for assessing potential impacts of certain activities and developments on key fish habitat types)
Freshwater habitats and brackish wetlands, lakes, and lagoons other than those defined in TYPE 1
Weir pools and dams up to full supply level where the weir or dam is across a natural waterway
TYPE 3 – Minimally sensitive KFH may include:
Unstable or unvegetated sand or mud substrate, coastal and estuarine sandy beaches with minimal or no in-fauna
Coastal and freshwater habitats not included in TYPES 1 or 2
Ephemeral aquatic habitat not supporting native aquatic or wetland vegetation

Table 6-92: Classification of waterways for fish passage (Fairfull 2013)

Classification	Characteristics of waterway class
CLASS 1 **Major KFH**	Marine or estuarine waterway or permanently flowing or flooded freshwater waterway (e.g. river or major creek), habitat of a threatened or protected fish species or 'critical habitat'.
CLASS 2 **Moderate KFH**	Non-permanently flowing (intermittent) stream, creek or waterway (generally named) with clearly defined bed and banks with semi-permanent to permanent waters in pool or in connected wetland areas. Freshwater aquatic vegetation is present. TYPE 1 and 2 habitats present.
CLASS 3 **Minimal KFH**	Named or unnamed waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g. fish, yabbies). Semi-permanent pools form within the waterway or adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or other CLASS 1-3 fish habitats.
CLASS 4 **Unlikely KFH**	Waterway (generally unnamed) with intermittent flow following rain events only, little or no defined drainage channel, little or no flow or free-standing water or pools post rain events (e.g. dry gullies or shallow floodplain depressions with no aquatic flora present).

Table 6-93: Preferred waterway crossing type (Fairfull 2013)

Preferred waterway crossing type in relation to waterway class		
Waterway classification	**Minimum Recommended Crossing Type**	**Additional Design Information**
CLASS 1 **Major key fish habitat**	Bridge, arch structure, or tunnel	Bridges are preferred to arch structures.
CLASS 2 **Moderate key fish habitat**	Bridge, arch structure, culvert[7] or ford	Bridges are preferred to arch structures, box culverts and fords (in that order).
CLASS 3 **Minimal key fish habitat**	Culvert[8] or ford	Box culverts are preferred to fords and pipe culverts (in that order).
CLASS 4 **Unlikely key fish habitat**	Culvert[9], causeway or ford	Culverts and fords are preferred to causeways (in that order).

[7] High priority given to the 'High Flow Design' procedures presented for the design of these culvert – refer to the 'Design Considerations' section of Fairfull and Witheridge (2003).

[8] Minimum culvert design using the 'Low Flow Design' procedures; however, 'High Flow Design' and 'Medium Flow Design' should be given priority where affordable – refer to the 'Design Considerations' section of Fairfull and Witheridge (2003).

[9] Fish friendly waterway crossing design possibly unwarranted. Fish passage requirements should be confirmed with NSW DPI.

Aquatic habitat within the Project Site ranged from poor to good, often depending on the surrounding land use and position in the catchment. Many of the 1st order streams were ephemeral and were dry even after rain in the previous week, with no aquatic macrophytes observed in the channel. Therefore, these watercourses would be considered Type 3 (minimally sensitive) KFH as per Table 6-91 as they may only flow after extended periods of rain. Larger order watercourses such as Oaky Creek and Little Oaky Creek would be considered Type 2 KFH as there was flowing water with macrophytes present. Watercourses would then be considered Class 2, 3 or 4 depending on their propensity to hold permanent water.

THREATENED AQUATIC SPECIES AND HABITATS

Waterways downstream of Lake Burrendong within the Project Site and the Cudgegong River downstream of Windamere Dam are within the Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River, an EEC listed under Schedule 4 of the FM Act. This EEC includes the lowland riverine environment, characterised by meandering channels and a variety of habitats, including deep channels, pools, wetlands, gravel beds and floodplains (DPI 2007). As an EEC, all native fish, and other aquatic animals within the boundaries of the catchment are given the status of endangered species.

In addition to the EEC, eight (8) species of threatened fish species or populations have been modelled to occur within waterways on-site or downstream of the Project Site (Figure 6-62). These include:

- Murray-Darling population of eel-tailed catfish (*Tandanas tandanas*) – Endangered (FM Act)
- Southern purple spotted gudgeon (*Mogurnda adspersa*) – Endangered (FM Act)
- Olive perchlet (*Ambassis agassizii*) – Endangered (FM Act)
- Silver Perch (*Bidyanus bidyanus*) – Vulnerable (FM Act)
- Trout Cod (*Maccullochella macquariensis*) – Endangered (FM Act and EPBC Act)
- Flathead Galaxias (*Galaxias rostratus*) – Critically Endangered (EPBC Act)
- Macquarie Perch (*Macquaria australasica*) – Endangered (FM Act and EPBC Act)
- Murray Cod (*Maccullochella peelii*) – Vulnerable (EPBC Act).

All species have been mapped by DPI Fisheries as having potential habitat on-site or nearby. While many waterways on-site are ephemeral and dry for most of the year, all of these species are able to persist in dams and deeper waterholes during dry periods, so have potential to occur.

6.11.1.3. Groundwater

The Lachlan Fold Belt (LFB) MDB fractured rock aquifer is the main groundwater source within the Project Site and surrounding region and underlies an area of 1,672 km^2. This groundwater source likely comprises fractured rock aquifers within the folded and fractured sedimentary lithological units. Whilst the main aquifer for the region is the fractured rock aquifer, groundwater may also be present within any shallow alluvial deposits associated with Lake Burrendong and nearby creeks (NSW DPI Water 2012; ELA 2020).

AQUIFERS

The fractured rock aquifer is unconfined and typically recharged by direct rainfall infiltration with groundwater flowing through fractures, joints, bedding plains, faults, and cavities within the rock mass. This aquifer is estimated to have a 'low to moderate' level of connection to the overlying surface water features with estimated travel time between surface water and groundwater considered to be years to decades (NSW DPI Water 2012).

GROUNDWATER QUALITY AND FLOW

Based on the available groundwater level data from registered bores in the region compared to topographic elevation, groundwater flow appears to follow the local topography and is likely to flow from the Project Site, located in the high elevation ridgeline areas present to the east and south (850 mAHD) of Lake Burrendong, towards the west and south-west (300 mAHD), discharging at Lake Burrendong and Macquarie and Cudgegong Rivers, which have been incised at the base of the ridgelines (BoM 2017). The salinity level of the groundwater can range across all beneficial use classes from fresh to saline (NSW DPI Water, 2017; ELA, 2020).

REGISTERED BORES

The Project Site topography consists of undulating valleys with more than 100 registered groundwater bores within 5 km of the Project. Only seven (7) of the bores include water level and/or salinity data (as indicated by the BoM Ground Water Explorer) with 5 km of the Project Site. They are predominately located at lower elevations within valleys and along creek/river lines to the south and west of Lake Burrendong. All bores are located at lower elevations than any of the proposed WTG sites and extrapolated water tables beneath the WTG sites would be expected to be significantly deeper than those recorded at existing bores. Table 6-94summarises the available groundwater data for the 20 bores, including Standing Water Level (SWL) in mAHD. Figure 6-63 shows the location and size of the Registered Bores in relation to the Project Site in mAHD while Figure 6-64 shows the location and size of the Registered Bores in relation to the Project Site in mBGL.

Table 6-94: Registered groundwater bore data within 5 km of the Project

Bore ID	Depth (m)	Drilled Date	Purpose	Status	SWL (mbgl)	SWL (mAHD)	TDS (ppm)	Elevation (m AHD)	Estimated Water Bearing Unit
GW013440	22.8	1956-11-01	Water Supply	Functioning	6	644	Hard		Fractured
GW031705	53.9	1968-12-01	Stock and Domestic	Unknown	8.2	391.8	Brackish		Fractured
GW059520	45.5	1982-07-01	Water Supply	Unknown	25.8	849.2	Fresh		Fractured
GW036899	70	1990-02-01	Monitoring	Functional	12	438		433.68	Fractured
GW051288	56.4	1980-09-01	Water Supply	Unknown	27.4	772.6			Fractured
GW029185	22.8	1968-03-01	Water Supply	Unknown	9.7	440.3			Consolidated
GW030605	30.5	1971-10-01	Water Supply	Unknown	5	845	0-500		Fractured
GW025119	44.1	1968-02-01	Water Supply	Unknown			501-1000		Fractured
GW025114	28.9	1968-02-01	Irrigation	Unknown			501-1000		Fractured
GW044793	15.2	--	Water Supply	Unknown	6.12	493.88			Unknown
GW031704	38.1	--	Water Supply	Non-functional	6	394	Brackish		Fractured
GW051409	23.2	1980-07-01	Water Supply	Unknown	6.1	843.9	Good		Fractured
GW011728	21.3	1956-09-01	Water Supply	Unknown			Hard		Fractured
GW025123	32.3	1968-02-01	Water Supply	Unknown	3.4	496.6	501-1000		Fractured
GW029184	22.8	1968-03-01	Stock and Domestic	Unknown	5.76	394.24			Consolidated
GW055763	12	1982-03-01	Water Supply	Unknown	4	546	Good		Fractured
GW045516	31.4	1951-01-01	Water Supply	Unknown			Fair		Unknown
GW025117	48.7	1968-02-01	Water Supply	Unknown			Good		Fractured
GW055393	45.7	1981-09-01	Water Supply	Unknown	30.5	819.5			Fractured
GW025122	24.3	1968-02-01	Water Supply	Unknown			501-1000		Fractured

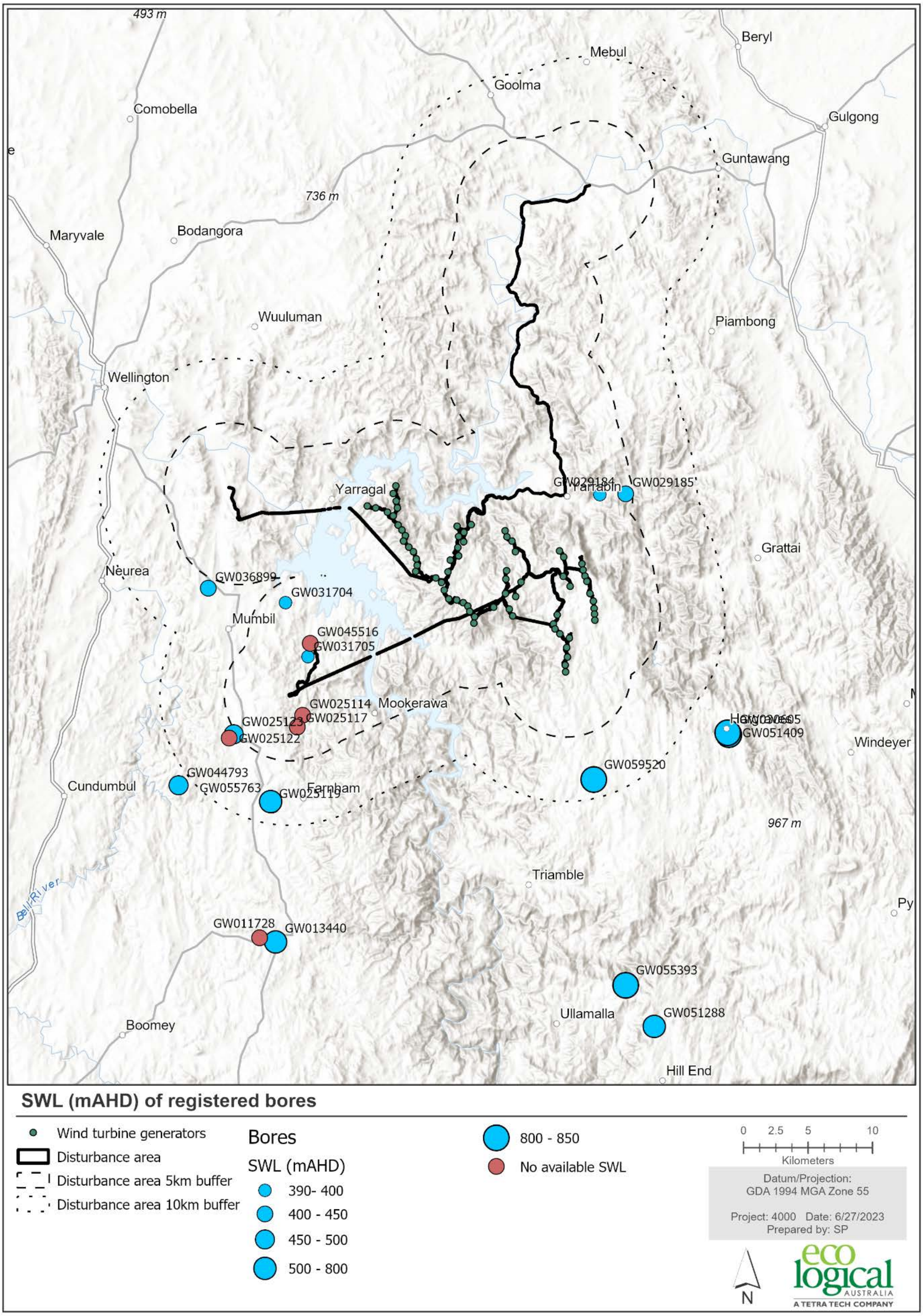


Figure 6-63: Registered bore locations within 5 km of the Project Site and groundwater table elevation (mAHD)

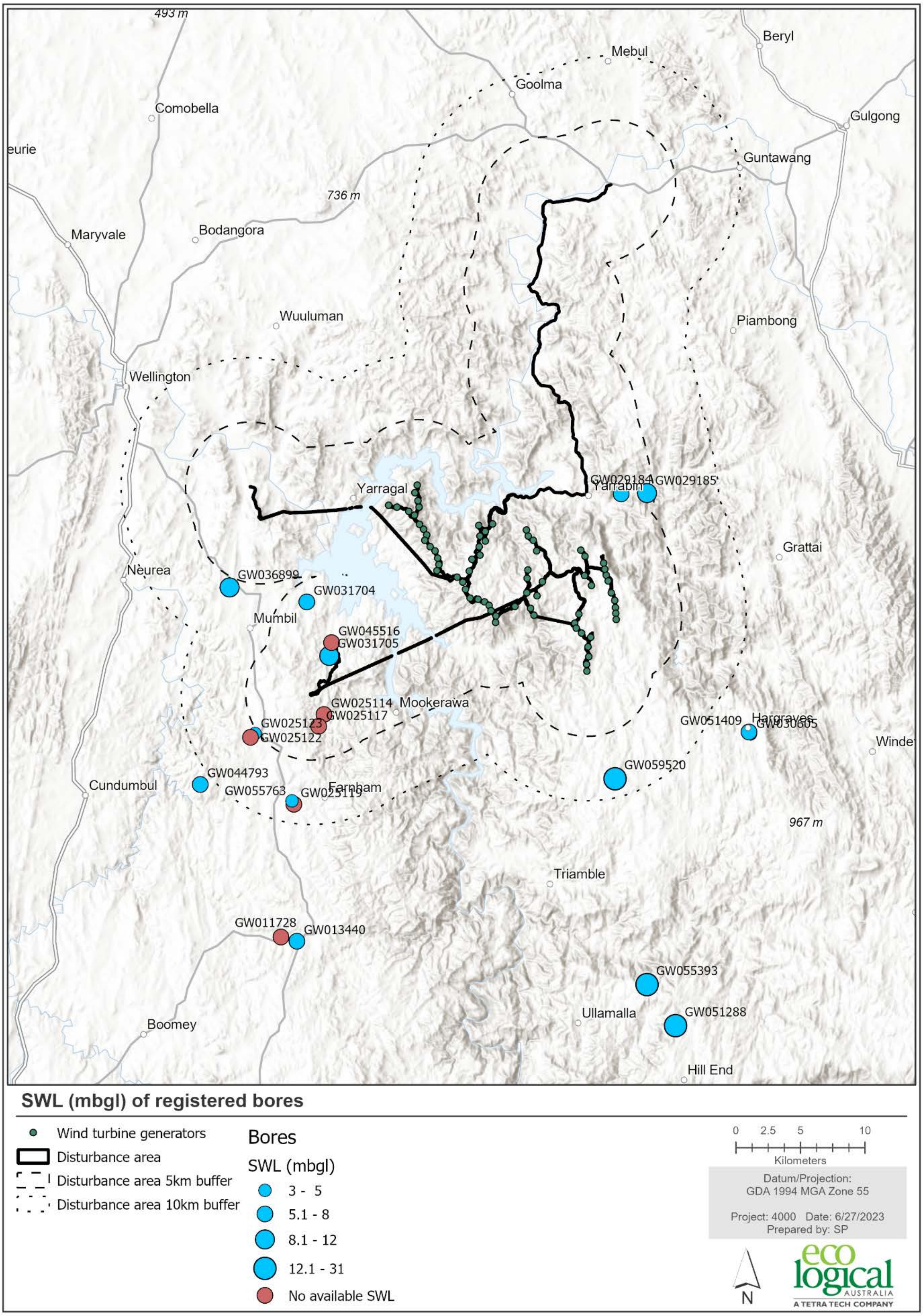


Figure 6-64: Registered bore locations within 5 km of the Project Site and SWL (mBGL) levels

GROUNDWATER AS A POTENTIAL WATER SUPPLY

The limited availability of productive groundwater bores as well as limited groundwater data for the region implies that groundwater is unlikely to be a productive source of water for the Project. Product water supply bores in the region are typically located in valley floors and have low yields (DPI, 2012). Local water supply for the Project may be possible as water quality is generally good, however multiple bores would be required to support the volumes required for development of the Project. If local supplies could be secured, licensing is unlikely to be an issue as the MDB Fractured Rock Groundwater Source is currently under-utilised (due to generally poor yields and availability of surface water supplies) (ELA, 2023e).

GROUNDWATER DEPENDENT ECOSYSTEMS

GDEs are ecosystems that have their species composition and natural ecological processes wholly or partially determined by groundwater (Geoscience Australia 2017).

A review of the GDE information provided in the WSP for the NSW Murray–Darling Basin Fractured Rock Groundwater Sources 2020 and the available mapped potential terrestrial and aquatic GDE information from the BoM Australian GDE Atlas (http://www.bom.gov.au/water/groundwater/gde/map.shtml) was undertaken and identified one high priority GDE (Pine Spring) within ~4 km of the Project Site. Pine Spring is classed as a Type 2 (aquatic) GDE.

In addition to Pine Spring, the following high potential Type 2 (aquatic) GDEs were identified within a 2 km buffer zone from the Project Site:

- Meroo River
- Macquarie River
- Cudgegong River
- Black Willow River
- Ben Buckley River.
- Gigmalerie River.
- Guroba River.
- Piambong River.
- Uamby River.
- Diggers River.

Table 6-95 details the high potential Type 3 (terrestrial) GDEs that were identified within a 2 km buffer of the Project Site, based on the BoM GDE Atlas data. The high potential Type 3 terrestrial vegetation has been summarised based on Plant Community Type (PCT). Figure 6-65 presents a map of the identified potential terrestrial and aquatic GDE locations in relation to the Project Site.

No known mapping of Type 1 (stygofauna) GDEs has been undertaken in the region.

Table 6-95: High potential Type 3 terrestrial GDEs identified within 2 km buffer zone of the Project Site

PCT	PCT Description
1330	Yellow Box - Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion.
281	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion.
78	River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregion.
5	River Red Gum herbaceous-grassy very tall open forest wetland on inner floodplains in the lower slopes sub-region of the NSW South Western Slopes Bioregion and the eastern Riverina Bioregion.
85	River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregion.
78	River Red Gum riparian tall woodland / open forest wetland in the Nandewar Bioregion and Brigalow Belt South Bioregoin
1103	Ribbon Gum - Yellow Box grassy woodland on undulating terrain of the eastern tablelands, South Eastern Highlands Bioregion.
323	Red Stringybark - Inland Scribbly Gum open forest on steep hills in the Mudgee - northern section of the NSW South Western Slopes Bioregion.
287	Long-leaved Box - Red Box - Red Stringybark mixed open forest on hills and hillslopes in the NSW South Western Slopes Bioregion.
277	Blakely's Red Gum - Yellow Box grassy tall woodland of the NSW South Western Slopes Bioregion.
3303	Central Tableland Ribbon Gum-Apple Gully Forest
186	Dwyer's Red Gum - Black Cypress Pine - Currawang shrubby low woodland on rocky hills mainly in the NSW South Western Slopes Bioregion
39	Coolabah - River Coobah - Lignum woodland wetland of frequently flooded floodplains mainly in the Darling Riverine Plains Bioregion
212	Chenopod low open shrubland - ephemeral partly derived forbland saline wetland on occasionally flooded pale clay scalds in the NSW North Western Plains
37	Black Box woodland wetland on NSW central and northern floodplains including the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion.
201	Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion
81	Western Grey Box - cypress pine shrub grass shrub tall woodland in the Brigalow Belt South Bioregion
274	White Box - Rough-barked Apple alluvial woodland of the NSW central western slopes including in the Mudgee region
278	Riparian Blakely's Red Gum – box – shrub – sedge – grass tall open forest of the central NSW South Western Slopes Bioregion

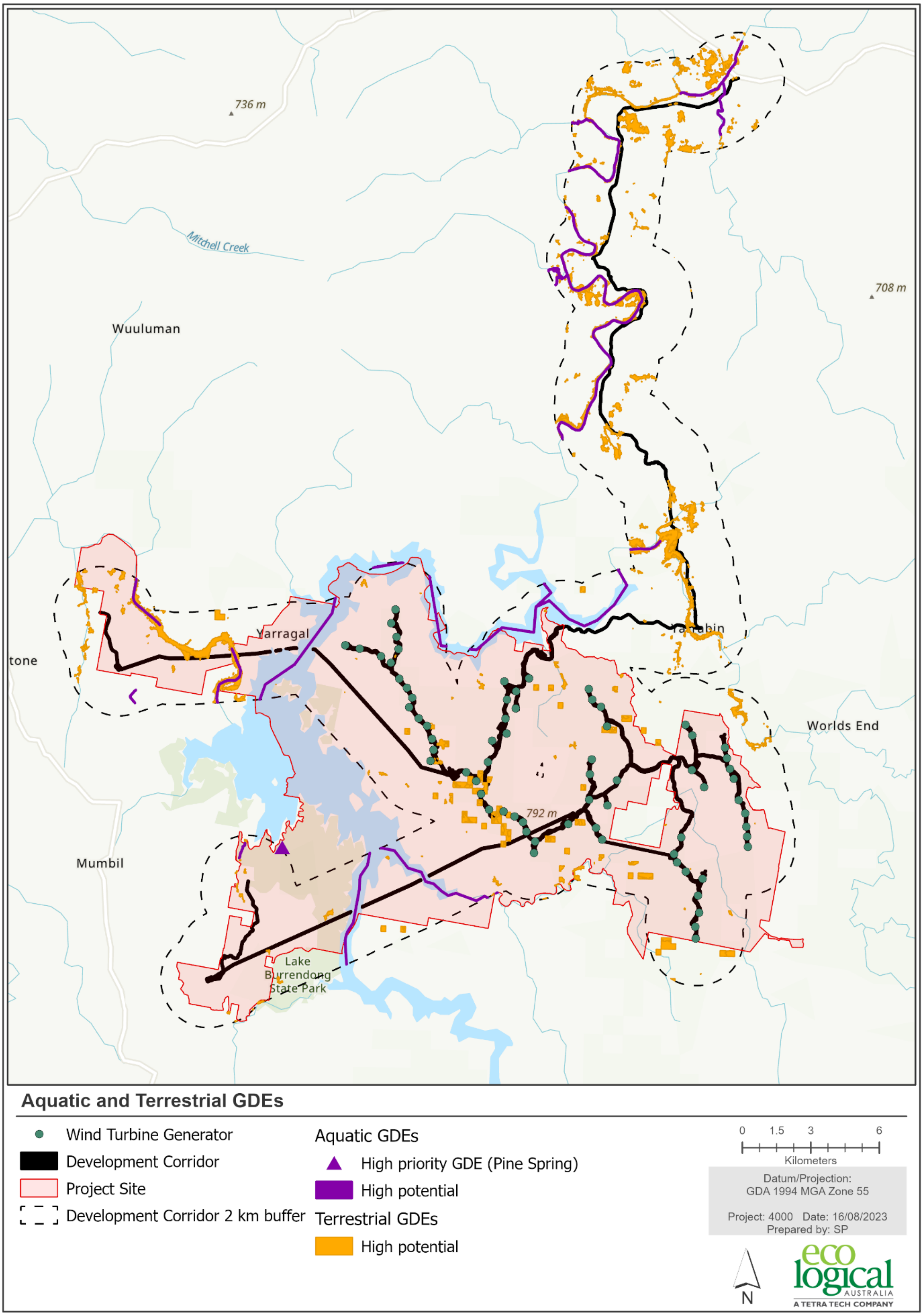


Figure 6-65: Identified high potential terrestrial and aquatic GDEs within 2 km buffer zone of the Project Site

6.11.2. Potential Impacts

6.11.2.1. Surface Water

For the water balance, water use estimates are required for all aspects of the construction that require water, specifically:

- Earthworks
- Dust suppression
- WTG footings
- Electricity transmission tower footings.

The water use information was provided by the Proponent for use in the water balance assessment. To support the modelling, daily climate datasets were sourced from the BoM online climate datasets.

Table 6-96: Supplied water balance information

Item	Description	Value
Rock Mass	Mass of rocks used for earthworks	7,806,757 tonnes
Soil and Rock Mass	Mass of conglomerate of rocks and soil used for earthworks	3,903,379 tonnes
Soil Mass	Mass of soil used for earthworks	3,903,379 tonnes
Rock Water Proportion	Proportion of rock mass that needs to be added as water to reach the optimum moisture content for earthworks	1%
Soil and Rock Water Proportion	Proportion of rock and soil conglomerate mass that needs to be added as water to reach the optimum moisture content for earthworks	7.5%
Soil Water Proportion	Proportion of soil mass that needs to be added as water to reach the optimum moisture content for earthworks	15%
Dust suppression application rate	Rate of water required to be applied to gravel roads to suppress dust during construction. Unit is millimetres per square metre per day of wetting.	2.5 – 5 mm/m^{2}d
WTG footing volume	Volume of water required for each WTG footing	0.15 ML/footing
Average road width	Width of road requiring dust suppression	5.5 m

CONSTRUCTION

A source, or sources, of water are needed for the Project for earthworks, WTG footings, transmission line footings and dust suppression during construction. Using the information outlined in Table 6-96, a water balance model was developed to quantify the likely water demand requirements for the Project. Details of the water balance model are presented in Appendix O with the results discussed below.

For the fixed water requirements for the Project, a total of 972.5 ML is estimated to be required for the earthworks (956 ML), the WTG footings (10.5 ML) and transmission line footings (6 ML). In addition to this is the amount of water required for dust suppression, the amount of which varies based on the length of road being actively used and the climate at the time.

Figure 6-66 illustrates the estimated volumes of water required for road dust suppression based on a 5.5 m wide road requiring water. The x-axis represents the distance of road being used for dust suppression at any one time (the total length of roads for the Project is 120 km). The lines refer to the number of days per year (or proportion of days per year) of irrigation required across the 30-year window, where:

- Minimum refers to the minimum amount of water required based on the wettest year in the series.
- Mean refers to the average amount of water required based on the average annual number of days requiring irrigation.
- Maximum refers to the maximum amount of water required based on the driest year in the series.
- Absolute maximum refers to the amount of water required if irrigation was required every day.

Figure 6-67 presents the same water use information as above, except for the length of transmission line on which water is being applied. The curves assume that only a road width (5.5 m) of the total cleared corridor (100 m) is required to be dust suppressed, as the other areas are not being trafficked. The proposed transmission line route is 17.2 km in length and passes over a section of Burrendong Dam.

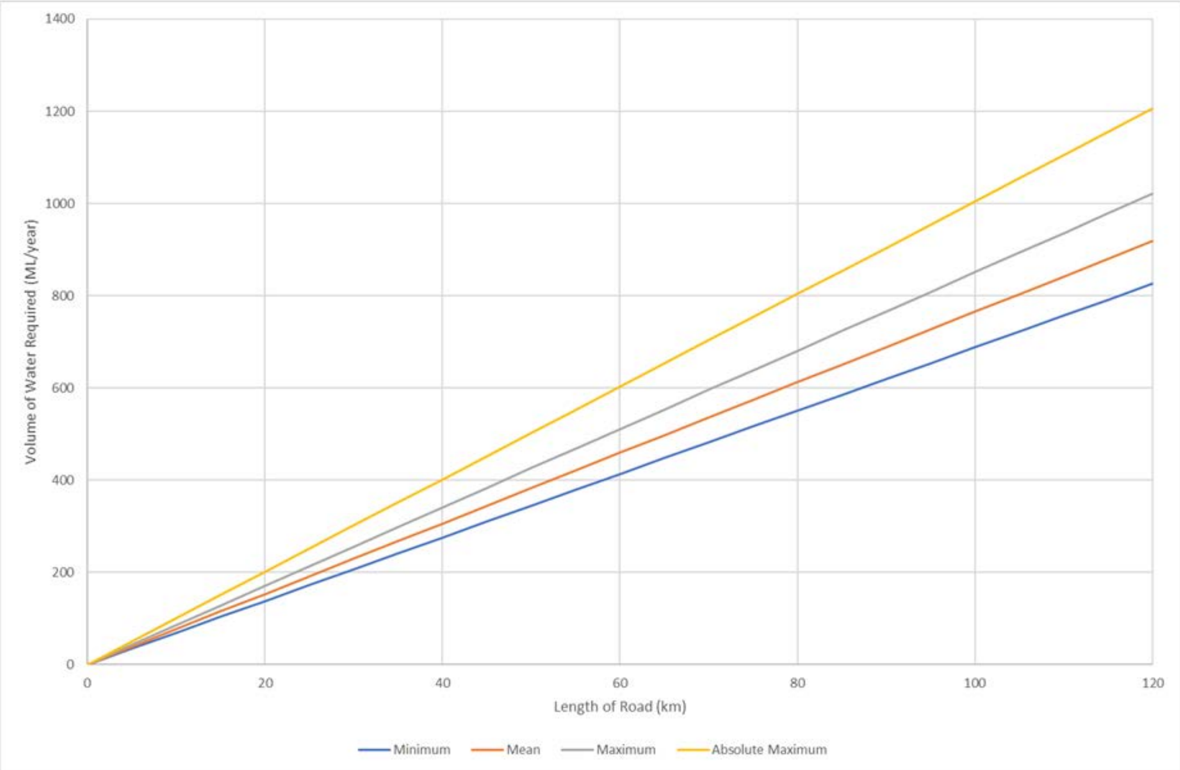


Figure 6-66: Road dust suppression water requirements

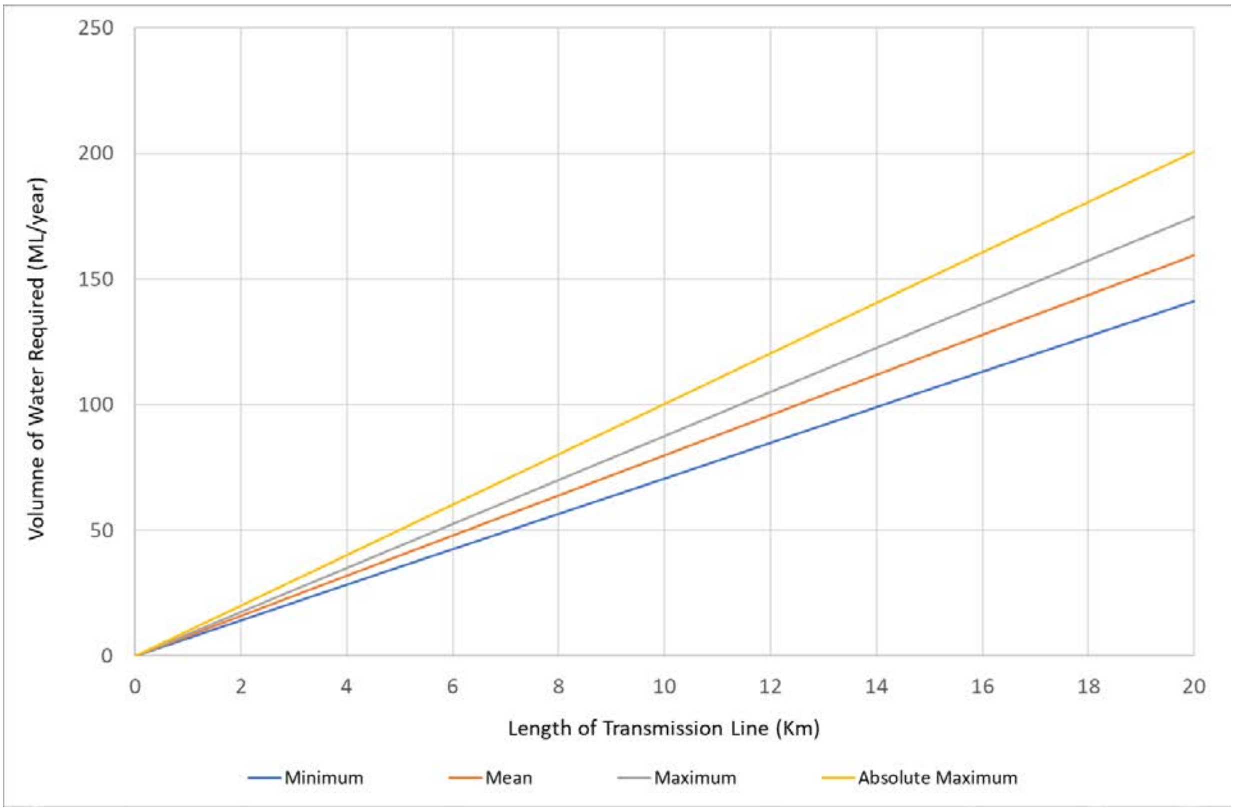


Figure 6-67: Transmission line dust suppression water requirements

The amount of water required for dust suppression works will need to be sourced from an appropriate location with the relevant licences. Sources of water nearby are the Macquarie River, Cudgegong River, Burrendong Dam, and catchment farm dams (used for stock). Some water may be able to be sourced from the farm dams, but the volume of water required will exceed the water availability from this source. Therefore, water will need to be sourced from the other nearby options or alternative water sources (with relevant licences).

OPERATION

During the operation of the WTGs, post construction, the water requirements are likely to be minimal. Should water be required, potential sources would be the catchment farm dams or water carts.

WATER QUALITY

The Project Site is situated where runoff drains to Lake Burrendong either directly or via its tributaries. This runoff is separated into sub-catchment regions, as shown in Figure 6-68, to identify where impacts may be occurring. These sub-catchments include named creeks and rivers that flow into Lake Burrendong and also local unnamed drainage areas (Figure 6-68). Sub-catchments Burrendong 0 to Burrendong 3 were not included as the updated project area does not impact these areas.

A MUSIC model was developed to represent the catchment runoff and water quality runoff (total suspended solids) from these catchments. The setup of the model for existing, developed, and mitigated conditions is discussed in Appendix O.

Mean annual flows from each of the sub-catchments are shown in Table 6-97. It is noted that catchments Burrendong 0, Burrendong 1, Burrendong 2 and Burrendong 3 were excluded from the MUSIC model due to changes in the proposed development footprint, as indicated in Table 6-97.

The increase in flow across the catchments are proportional to the developed area and are expected given the clearing of land for the WTGs and access tracks because of the increase in overall impervious area and relative runoff.

Table 6-97: Mean annual flow for each catchment

Catchment	Total Area (ha)	Existing Flow (ML/yr)	Developed Flow (ML/yr)	Developed Area (ha)	Increase in Flow (ML/yr)
Burrendong 0	583	67	67	0	0
Burrendong 1	213	16	16	0	0
Burrendong 2	872	65	65	0	0
Burrendong 3	211	23	23	0	0
Burrendong 4	585	70	87	7	17
Burrendong 5	618	74	91	7	17
Burrendong 6	138	17	28	4	11
Burrendong 7	121	15	25	4	10
Burrendong 8	126	15	18	1	3
Burrendong 9	191	23	30	3	7
Cudgegong River	57,931	7,770	8,760	393	990
Devils Hole Creek	1,349	162	315	61	153
Dog Trap Gully	468	56	128	28	72
Harrys Creek	621	74	93	7	19
Macquarie River	10,215	1,230	1,330	36	100
Oaky Creek	4,930	665	671	2	6
Pine Spring Diggers Creek	18,282	2,190	2,770	227	580
Spring Creek	2,994	380	482	40	102

Mean annual total suspended solids (TSS) loads from each of the sub-catchments are shown in Table 6-98. The results show that there is a significant increase in the sediment runoff from the Project (prior to any mitigations). These impacts are expected due to the changing of lands uses from forest or grazing land to gravel roads and construction pads pre-Project (existing conditions) to post-Project (Developed Conditions). Therefore, mitigation measures (Section 6.11.3) would be required to minimise their impact.

Table 6-98: Existing and developed condition TSS loads

Catchment	Total Area (ha)	Existing Conditions (kg/yr)	Developed Area (ha)	Developed Conditions (kg/yr)
Burrendong 4	585	3,520	7	21,400
Burrendong 5	618	1,380	7	18,700
Burrendong 6	138	308	4	11,800
Burrendong 7	121	271	4	11,100
Burrendong 8	126	282	1	3,410
Burrendong 9	191	428	3	7,510
Cudgegong River	57,931	534,000	393	1,560,000
Devils Hole Creek	1,349	3,010	61	161,000
Dog Trap Gully	468	1,050	28	75,200
Harrys Creek	621	1,390	7	20,900
Macquarie River	10,215	73,400	36	168,000
Oaky Creek	4,930	48,400	2	54,100
Pine Spring Diggers Creek	18,282	94,800	227	687,000
Spring Creek	2,994	26,300	40	132,000

The results presented in Table 6-98 show that impacts will occur within the Burrendong Water Catchment Area, Lake Burrendong (its locally draining catchments), Macquarie River and Cudgegong River areas. Therefore, any potential detrimental water quality impacts across these water resources need to be considered as part of this assessment. While specific mitigation measures to address impacts to these water areas are detailed in Section 6.11.3, it is noted that the majority of disturbance from the Project is in the very upper catchment and that would provide additional buffer to any sediment that runs off (after mitigation measures are applied).

SURFACE WATER CONTAMINATION

Fuels, lubricants, and other chemicals will be used on site during construction activities and pose a potential contamination risk to surface water in the event of a spill. Contaminants in the soil may also be mobilised during rainfall events and may potentially enter nearby watercourses, potentially impacting surface water quality for third party users.

Management of temporary sewage systems established onsite for the duration of the Project also pose a risk to surface water quality should spills occur.

Potential contamination sources during the operational phase of the Project would be the result of servicing of the WTGs, heavy machinery, transformers and batteries on site, oils from the transformers on site and battery electrolytes. Storage of these materials will also be onsite. Potential impacts include leaks, drips, and spills of these materials.

6.11.2.2. Riparian Land and Aquatic Ecosystems

CONSTRUCTION

The construction of the WTGs, access tracks and ancillary structures have the potential to impact on aquatic ecosystems within the Project Site and downstream, predominantly where these activities cross or are to be constructed within close vicinity to waterways. Where it is necessary for infrastructure to cross waterways, construction should occur during periods of no-flow to minimise impacts to aquatic ecosystems.

Access tracks should be designed in accordance with Policy and guidelines for fish habitat conservation and management (Fairfull 2013), Guidelines for watercourse crossings on waterfront land (DPI Water, 2012) and Why do fish need to cross the road? Fish passage requirements for waterway crossings (Fairfull and Witheridge 2003). The design of these crossings will be based on the KFH type and waterway class and as per Table 6-93. Impacts to threatened aquatic fauna and the endangered aquatic community have been assessed in Appendix H, as per Section 220ZZ of the FM Act. These assessments concluded that it is unlikely the proposed works would have a significant impact on threatened aquatic species, populations, and communities.

If the proposed watercourse crossings require revetment walls, pylons, or culverts to be installed within the creek line or bank, there may be the need to ensure that the immediate works area is dry to allow machinery to move freely within the area as well as to prevent waste material and dust entering the water. This would require dewatering of the works area (if water is present), which would temporarily block fish passage through the reach. Spawning and migration for the threatened aquatic species listed in Section 6.11.1.2 occurs in spring and summer, so construction of watercourse crossings and activities on waterfront land should be avoided during these periods.

Removal of riparian vegetation for the construction of watercourse crossings may destabilise sections of the creek bank within these areas. If the creek banks are destabilised, this could lead to erosion of the adjacent banks and subsequent sedimentation of the water. This may increase the turbidity of the water which would limit the amount of sunlight penetrating the water column and affect plant growth and fish health. If bank erosion was to continue, this could lead to the loss of further riparian land and potentially impact any assets within this area.

The construction of watercourse crossings has the potential to cause indirect impacts to aquatic ecosystems. Construction of a new crossing over a watercourse would cause shading of the waterway. Although in some areas the waterways may be currently partly shaded by vegetation, additional shading would decrease the amount of light available for growth of instream and riparian vegetation and aquatic fauna. The higher the bridge, the less shading impact would occur. Culvert types and sizes should be designed in accordance with the guidelines to avoid constricted flows and dark zones that would impact free fish passage.

Where disturbance from construction associated with the watercourse crossings or WTGs and ancillary structures results in bare ground or increased sunlight penetration into riparian areas, there is the potential for invasion of exotic flora species. The movement of construction vehicles in and around the riparian area can also act as a vector for weed propagules. Impacts include introduction of new weeds to the area and extended penetration of weeds into native plant communities. This may result in a loss of biodiversity and habitat value, smothering of native juvenile plants, harbouring of feral animals and alteration of vegetation structure and riparian function. For example, shallow-rooted weedy groundcovers may outcompete native tree seedlings that would usually stabilise the banks with deeper roots.

OPERATION

Operational impacts of the proposed project to aquatic habitats are likely to be negligible, as infrastructure to protect watercourses (such as bridges over larger order streams and fish friendly culverts) would have been installed during the construction stage of the project.

6.11.2.3. Groundwater

WATER TABLES AND RECHARGE ZONES

The Project Site topography consists of undulating valleys, with registered groundwater bores within 5 km of the Project Site predominately located at lower elevations, within valleys and along creek/river lines to the south and west of Lake Burrendong.

In contrast, the proposed WTG locations and infrastructure are to be located at higher elevations along ridgelines, or zones of relatively high elevation to the north and east of the reservoir.

All bores are thus located at lower elevations than any of the proposed WTG sites and extrapolated water tables beneath the WTG sites would be expected to be sufficiently deep to not be impacted by construction or operation activities. An example of this situation can be seen in X at registered bore GW059520, located in the vicinity of the WTG sites (~6 km) and Project Site, where static groundwater level has been recorded up to 30 mbgl (equivalent to 849.2 m AHD).

Installation of the WTG is understood to include excavations and/or installation of piling to a total depth of 6 mbgl along the ridgelines. The significant thickness of the vadose (or unsaturated zone) above the water table assures that construction of the Project is highly unlikely to intercept groundwater.

Site ridges and their associated valleys, however, may represent significant recharge zones for LFB aquifers. The significant vadose zone thickness within the Project Site means that any potential impacts may not be expressed for many years. The minimal impervious footprint of individual WTGs and associated infrastructure (as determined for the surface water modelling (ELA 2022d) and very short diversion paths at impervious locations, however, suggests minimal to no expected impact to recharge from the Project.

KARST FEATURES

NSW karst maps (as identified using “Natural Resource – karst map – NRK_004”) indicate that there is an overlap between Project Site and extant karst features. Karst features may present a sinkhole risk and may modify the landscape if construction plans are conducted in intersecting areas. Whilst unlikely to impact development, evidence of these features should be investigated during detailed geotechnical investigations at each WTG site.

GROUNDWATER DEPENDENT ECOSYSTEMS

Based purely on the locations of identified potential GDEs (Figure 6-65), the Project-related infrastructure (WTG and substation) may potentially impact high potential Type 2 aquatic GDEs (including Pine Spring) and high potential Type 3 terrestrial GDEs (Table 6-95).

As previously discussed, it is unlikely, based on known groundwater data, that there will be any aquifer interference during construction. Therefore, groundwater-related impacts to the high priority aquatic GDE (Pine Spring) and high potential aquatic and terrestrial GDEs, are not anticipated.

POTENTIAL GROUNDWATER CONTAMINATION

Fuels and lubricants will be used on site during construction activities and pose a potential risk of contamination to groundwater in the event of a spill. Contaminants in the soil may also be mobilised during rainfall events and may potentially enter the groundwater system, potentially impacting groundwater quality for third party groundwater users, GDEs and/or aquatic habitats.

Management of temporary sewage systems established onsite for the duration of the Project also pose a risk to surface water quality should spills occur.

It is important that Industry Standard spill minimisation and response procedures are followed, which will reduce and minimize any potential groundwater contamination during construction.

AIP LEVEL 1 MINIMAL IMPACT CONSIDERATION CRITERIA

ELAs' assessment concludes that potential impacts to groundwater in the Project Site will not exceed the Level 1 impact considerations under the Aquifer Interference Policy (AIP) (DPI 2012) as defined in Table 6-99 for 'low productivity' fractured rock aquifers. That is, the Project poses less than a minimal impact to groundwater resources and associated dependencies and any potential impacts are therefore acceptable under the AIP.

Specifically, activities over the fractured rock aquifers are extremely unlikely to extend to a depth that intercepts the water table and hence will not result in a change in water levels. Water tables are also interpolated to be at sufficient depth that no water quality impacts are expected (but see Mitigation Measures in Section 6.11.3).

The only interactions in the vicinity of the alluvial aquifers will involve development of new roads and powerline tracks. Any temporary impacts during construction will be managed through sound practice and monitored through the CEMP. No significant impacts are expected at these sites.

Table 6-99: Minimal impact considerations for AIP Activities (Level 1) (sourced from AIP 2012)

Water Source	Water Table	Water Pressure	Water Quality
Fractured Rock	1. Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any: a. High priority groundwater dependent ecosystem; or b. High priority culturally significant site; listed in the schedule of the relevant water sharing plan. A maximum of a 2m decline cumulatively at any water supply work. 2. If more than 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any: a. High priority groundwater dependent ecosystem; or b. High priority culturally significant site; listed in the schedule of the relevant water sharing plan if appropriate studies demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than a 2 m decline cumulatively at any water supply work then make good provisions should apply.	1. A cumulative pressure head decline of not more than a 2 m decline, at any water supply work. 2. If the predicted pressure head decline is greater than requirement 1 above, then appropriate studies are required to demonstrate to the Minister's satisfaction that the decline will not prevent the long-term viability of the affected water supply works unless make good provisions apply.	1. Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity. 2. If condition 1 is not met then appropriate studies[1] will need to demonstrate to the Minister's satisfaction that the change in groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works
Alluvial aquifer	1. Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any: a. High priority groundwater dependent ecosystem; or b. High priority culturally significant site; listed in the schedule of the relevant water sharing plan.	1. A cumulative pressure head decline of not more than 40% of the "post-water sharing plan" pressure head above the base of the water source to a maximum of a 2 m decline, at any water	1. (a) Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity. (b) No increase of more than 1% per activity in long-term average salinity in a highly connected[1] surface water source at the nearest point to the activity. Redesign of a highly connected surface water source that is defined as a "reliable water supply" is not an appropriate mitigation measure to meet considerations 1(a) and 1(b) above.

Water Source	Water Table	Water Pressure	Water Quality
	A maximum of a 2 m decline cumulatively at any water supply work. 2. If more than 10% cumulative variation in the water table, allowing for typical climatic “post-water sharing plan” variations, 40 m from any: a. High priority groundwater dependent ecosystem; or b. High priority culturally significant site; listed in the schedule of the relevant water sharing plan if appropriate studies demonstrate to the Minister’s satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than a 2 m decline cumulatively at any water supply work then make good provisions should apply.	supply work a 2 m decline, at any water supply work. 2. If the predicted pressure head decline is greater than requirement 1 above, then appropriate studies are required to demonstrate to the Minister’s satisfaction that the decline will not prevent the long-term viability of the affected water supply works unless make good provisions apply.	(c) No mining activity to be below that natural ground surface within 200 m laterally from the top of high bank or 100 m vertically beneath (or the three-dimensional extent of the alluvial water source – whichever is the lesser distance) of a highly connected surface water source that is defined as a “reliable water supply”. (d) Not more than 10% cumulatively of the three-dimensional extent of the alluvial material in this water source to be excavated by mining activities beyond 200 m laterally from the top of high bank and 100 m vertically beneath a highly connected surface water source that is defined as a “reliable water supply”. 2. If condition 1(a) is not met then appropriate studies will need to demonstrate to the Minister’s satisfaction that the change in groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works. If condition 1(b) or 1(d) are not met then appropriate studies are required to demonstrate to the Minister’s satisfaction that the River Condition Index category of the highly connected surface water source will not be reduced at the nearest point to the activity. If condition 1(c) or 1(d) are not met, then appropriate studies are required to demonstrate to the Minister’s satisfaction that: - There will be negligible river bank or high wall instability risks; - During the activity’s operation and post-closure, levee banks and landform design should prevent the Probable Maximum Flood from entering the activity’s site; and - Low-permeability barriers between the site and the highly connected surface water source will be appropriately designed, installed and maintained to ensure their long-term effectiveness at minimising interaction between saline groundwater and the highly connected surface water supply.

Water Source	Water Table	Water Pressure	Water Quality

NOTES:

1. “post-water sharing plan” – refers to the period after the commencement of the first water sharing plan in the water source, including the highest pressure head (allowing for typical climatic variations) within the first year after commencement of the first water sharing plan.

2. “Appropriate studies” on the potential impacts of water table changes greater than 10% are to include an identification of the extent and location of the asset, the predicted range of water table changes at the asset due to the activity, the groundwater interaction processes that affect the asset, the reliance of the asset on groundwater, the condition and resilience of the asset in relation to water table changes and the long-term state of the asset due to these changes

3. “Highly connected” surface water sources are identified in the Regulations and will be based those determined during the water sharing planning process

4. “Reliable water supply” is as defined in the Strategic Regional Land Use Policy (SRLUP)

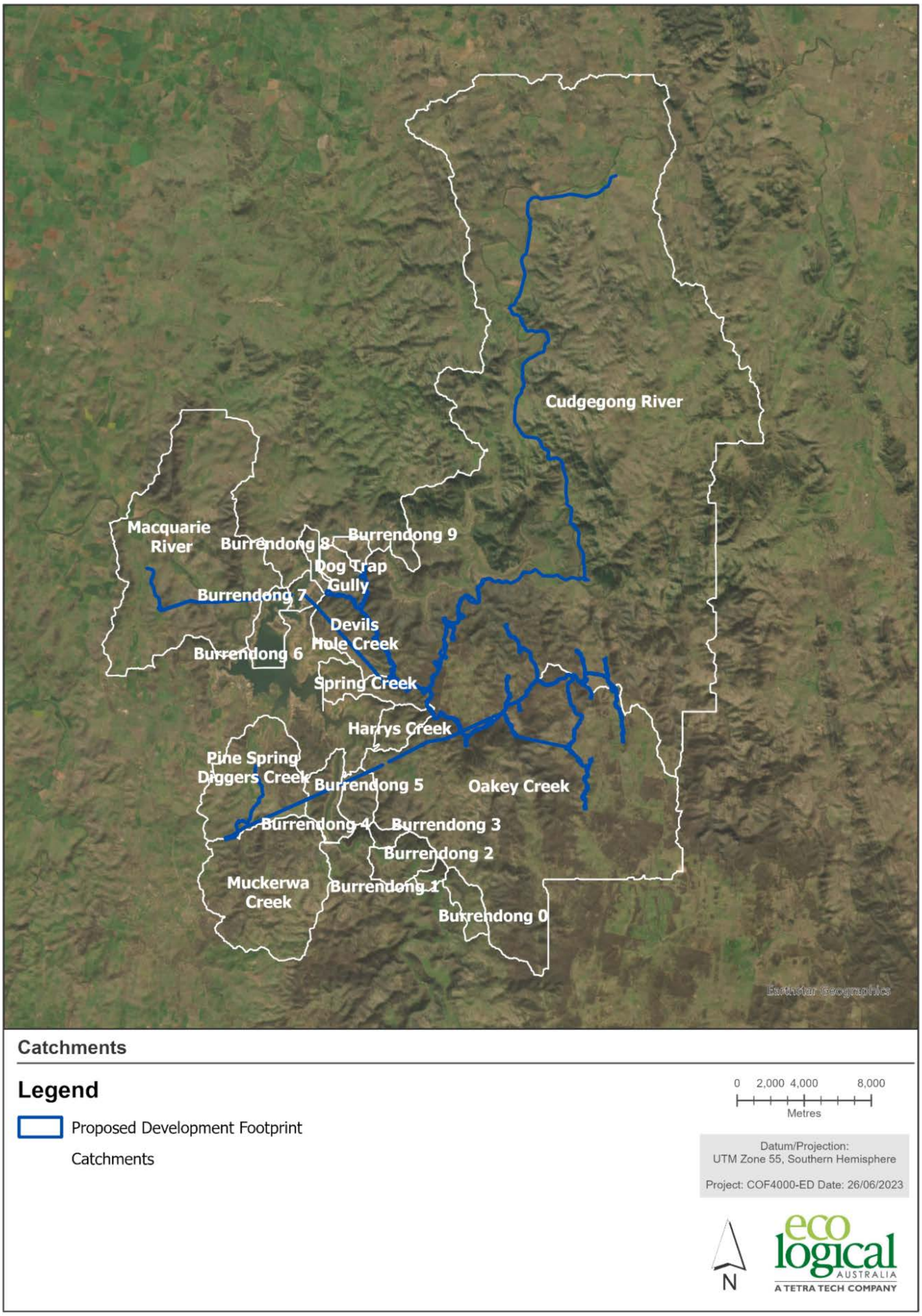


Figure 6-68: Catchments used in modelling. Note: Catchments Burrendong 0, Burrendong 1, Burrendong 2 and Burrendong 3 were excluded from the MUSIC model due to changes in the proposed development footprint

6.11.2.4. Flooding

Flooding is also an issue that may impact or be impacted by the Project. Specific flood modelling has not been undertaken in the assessment as the works being undertaken as part of the Project are predominantly in the upper catchments that have minimal impact upon the movement of flood waters. Where flooding could pose an issue is where the access roads cross creek lines to reach the WTG locations in these upper catchments. Should causeways be upgraded to support the passing of equipment to the Project, appropriate design considerations should be undertaken to ensure potential flood impacts are managed (i.e., not altering flow paths).

6.11.3. Mitigation Measures

Table 6-100 outlines the proposed measures to mitigate potential Surface Water, Groundwater, and Aquatic Ecology impacts.

Table 6-100: Mitigation Measures for Surface Water, Groundwater and Aquatic Ecology Impacts

Environmental Impact	Mitigation Measure	Reference Code
Groundwater	As part of the EMP, prepare a Water Quality Management Plan (WQMP). The WQMP must include: • Water quality monitoring program, which includes suitable measures to monitor and record on water quality of watercourses directly impacted from construction	GW001
	Where feasible establish the required VRZs on either side of watercourses with reference to the Guidelines for Controlled Activities on Waterfront land – Riparian Corridors (NRAR, 2018)	GW002
	Where feasible, design and construct watercourse crossings with reference to the following: • *Controlled activities on waterfront land – Guidelines for Watercourse Crossings on Waterfront Land* (DPI Water 2012) • *Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge 2003) • *Controlled Activities: Guidelines for Laying Pipes and Cables in Watercourses on Waterfront Land* (DPI Water 2012)	GW003
	Evidence of karst features should be investigated during detailed geotechnical investigations at each WTG site. Identified karst features to be isolated and protected	GW004
	The management of temporary sewerage systems established onsite for the duration of the Project also pose a risk to surface water quality should a spill occur. It is important that Industry Standard spill minimisation and response procedures are followed, which will reduce and minimise any potential groundwater contamination during construction.	GW005
Groundwater Dependent Ecosystems	Impacts to potential groundwater dependent ecosystems at creek crossings are to be managed through the site-specific CEMP. Consideration could be taken with regard to the *Policy and guidelines for fish habitat conservation and management* (Fairfull,	GDE01

Environmental Impact	Mitigation Measure	Reference Code
	2013). If the proposed watercourse crossings require revetment walls, pylons, or culverts to be installed within the creek line or bank, there may be the need to ensure that the immediate works area is dry to allow machinery to move freely within the area as well as to prevent waste material and dust entering the water. This would require dewatering of the works area (if water is present), which would temporarily block fish passage through the reach. Spawning and migration for the threatened aquatic species with potential to be found within the Project Site occurs in spring and summer, so construction of watercourse crossings and activities on waterfront land should be avoided during these periods.	
	To manage potential impacts to groundwater dependent ecosystems, take groundwater levels and quality measurements during geotechnical investigations.	GDE02
Water Quality and Quantity	Industry Standard spill minimisation and response procedures are followed, which will reduce and minimise any potential groundwater contamination during construction.	WQ001
	Prior to construction, place erosion and sediment controls within the immediate works area and downstream to prevent sediment and waste material entering the water column with an aim of achieving no visible turbid plumes within the water column.	WQ002
	To manage downstream flows and erosion, consider appropriate stormwater devices such as culverts, rock armouring, scour protection and/or detention basins	WQ003
	The results from the water balance modelling (ELA, 2022q) estimate the magnitude of water required to produce the footings, prepare the earthworks, and undertake dust suppression activities. Organising activities to minimise the length of roads in operation (i.e., that require dust suppression) and coordinating when earthworks are being prepared should be considered to reduce the amount of water needing to be sourced for the Project.	WQ004
	Should causeways be upgraded to support the passing of equipment to the Project, appropriate design considerations should be undertaken to ensure potential flood impacts are managed (i.e., not altering flow paths).	WQ005
	The inclusion of sediment basins and swales within the detailed design should be considered to reduce TSS loads entering downstream environments.	WQ006
	Implement facing material, such as sediment bunds, along specific drainage lines / waterways within the Development Footprint to reduce localised scour and erosion and provide ongoing maintenance.	WQ007

6.12 Resource and Waste Management

An assessment of the resource requirements for the Project and the waste that will be generated has been undertaken by ELA. The assessment has been undertaken in accordance with the requirements of the SEARs, which include:

- *Identify, quantify, and classify the likely waste streams to be generated during all stages of the Project, and describe the measures to be implemented to reduce waste generation, manage, reuse, recycle, and safely dispose of waste*

Assessment Overview

This assessment identifies waste management risks, and how these risks would be managed. It classifies the types of waste that would be generated by the project and proposes mitigation measures to manage and minimise these wastes.

The Project design evolution process seeks to minimise the Development Footprint, while maintaining power generation capacity. Where feasible, materials will be reused or repurposed to avoid redirection to waste.

The consumption of resources, and production and disposal of waste has the potential to have a negative impact upon the environment, and needs to be managed to ensure that:

- Resources are used efficiently
- Waste production is minimised
- Reuse of materials is maximised
- Contamination of land and water is avoided.

The WARR Act includes resource management hierarchy principals to encourage the most efficient use of resources and to reduce environmental harm. The Project's resource management options are considered against the following order:

- Avoidance of unnecessary resource consumption
- Resource recovery (including reuse, reprocessing, recycling, and energy recovery); and then
- Disposal.

The Project aims to adopt these principals to encourage the most efficient use of resources and reduce costs and environmental harm in keeping with the principles of ESD.

The generation of waste because of the Project would not cause any significant adverse impacts if managed effectively and in line with the mitigation measures described in Section 6.12.3. Adequate arrangements can be made throughout the various stages of the Project to ensure resource reuse and waste disposal complies with the relevant legislative requirements.

6.12.1. Existing Environment

The north of the Project Site is characterised predominantly by areas of managed resource protection which contain stands of native vegetation. To the south of the site, portions of the Project Site within the disturbance boundary have been historically cleared for grazing and agricultural works. However, large tracts of connected native vegetation still exist which are utilised as areas of nature conservation. Responsibility for the management of waste generated by activities within these areas currently lies with the landholders.

6.12.1.1. Resource Management Facilities

The Project will require the procurement of resources from several facilities, including from resource management facilities outlined in Table 6-101. Online research was conducted to gain further information about waste facilities that could be used by the Project, with phone enquiries undertaken where necessary. In particular, the following information was determined:

- Ability to accept commercial and construction waste
- Ability to accept recycled waste
- Daily and weekly capacity
- Whether other major projects in the locality (in construction or operational) had put a strain on operations

Note that for this assessment, commercial, construction and recycled waste were defined as follows:

- Commercial Waste: Waste that is generated during the normal course of commercial activities. This can include organic and non-organic waste materials that are sent to landfills. In this instance commercial waste related to the quantity (i.e., 10 tonnes).
- Construction Waste: The development of the Project will result in the production of construction waste because of construction works on site. Construction and demolition activities can generate a wide range of waste materials, including excavated material (i.e., rock and soil), waste asphalt, bricks, concrete, plasterboard, timber, and vegetation as well as asbestos and contaminated soil in some instances.
- Recycled Waste: This type of waste is any form of waste generated from the construction, operation or decommission of the Project that has the capability to be reused or recycled (i.e., rocks and topsoil etc.)

There are several waste recovery and disposal centres nearby including the Dubbo Community Recycling Centre, Wellington Waste Transfer Station, and Mudgee Waste Facility, managed by DRC and MWRC respectively. Private waste contractors that service the area include JR Richards & Sons, Cleanaway Dubbo Solid Waste Services and Mudgee-Gulgong Mini Skips & Waste Services. The Mudgee Waste Facility just north of Mudgee was identified as the most appropriate facility to use for waste disposal associated with the Project. This is based on their ability to accept both commercial and recycling waste as well as their proximity to the Project where most of the infrastructure will occur (Figure 1-2). It is noted that the Uungula Wind Farm identified the Wellington Waste Transfer Station and Whylandra Waste and Recycling Centre as the most appropriate facilities for their works.

Under the waste definitions in the POEO Act, most of the waste generated during the construction phase would be classified as general solid waste, either putrescible or non-putrescible. Putrescible waste is solid waste that contains organic materials that can be decomposed by microorganisms such as household waste, food, and animal waste. Non-putrescible waste is not subject to decay and include waste such as garden waste, virgin excavated materials, building and demolition waste. Staff facilities such as transportable amenities buildings at the site would also produce sanitary wastes defined as general solid wastes (putrescible) in accordance with the relevant waste definitions under the POEO Act.

Table 6-101: Resource and Waste Management Facilities in proximity to the Project Site

Resource / Waste Facility	Address	Approx. Distance from Project Site	Facility Type	Accepts Commercial Waste	Accepts Recycling
Waste Transfer Station - Wellington	83 Nanima Village Road, Wellington	78.4 km	Transfer Station	No	Yes
Mudgee Waste Facility	31 Blain Road, Caerleon 2850	45.6 km	Landfill	Yes	Yes
JR Richards & Sons	20B Sydney Road, Mudgee 2850	52.8 km	Waste and recycling transfer	Yes	Yes
Kandos Waste Facility	110 Kandos Tip Road, Kandos 2848	97.5 km	Waste facility	No	Yes

Note: all distances are approximate and based of Google Maps (2023)

QUARRIES

The Project will potentially require quarries and resource suppliers to support the development of the Project. The quarries are outlined in Table 6-102.

Table 6-102: Potential local quarries within 150 km of the Project Site

Quarry	Address	Approx Distance from Project Site by Road
Dubbo Hardrock Quarry	10R Lagoon Creek Road, Minore NSW 2830	141 km
Boral Quarries 1	7 Old Gilgandra Road, Brocklehurst NSW 2830	130 km
Boral Quarries 2	69 Putta Bucca Road, Mudgee NSW 2850	39 km
Holcim Quarries	22L Sheraton Road, Dubbo NSW 2830	122 km
Mudgee Dolomite & Lime	19 Buckaroo Lane, Mount Knowles NSW 2850	48 km
Brogans Creek Quarry	Clandulla NSW 2848	108 km
Boomey Quarry	653 Three Rivers Road, Boomey 2866	131 km
Central West Gravel	4001 Mitchell Highway, Molong NSW 2866	138 km
Earth Quarries	51 Bloomfield Road, Molong NSW 2866	142 km

6.12.1.2. Water Providers

Water providers have not been determined at this stage of the development process. It is anticipated that wherever practical, local water providers would be used to source water during the construction phase.

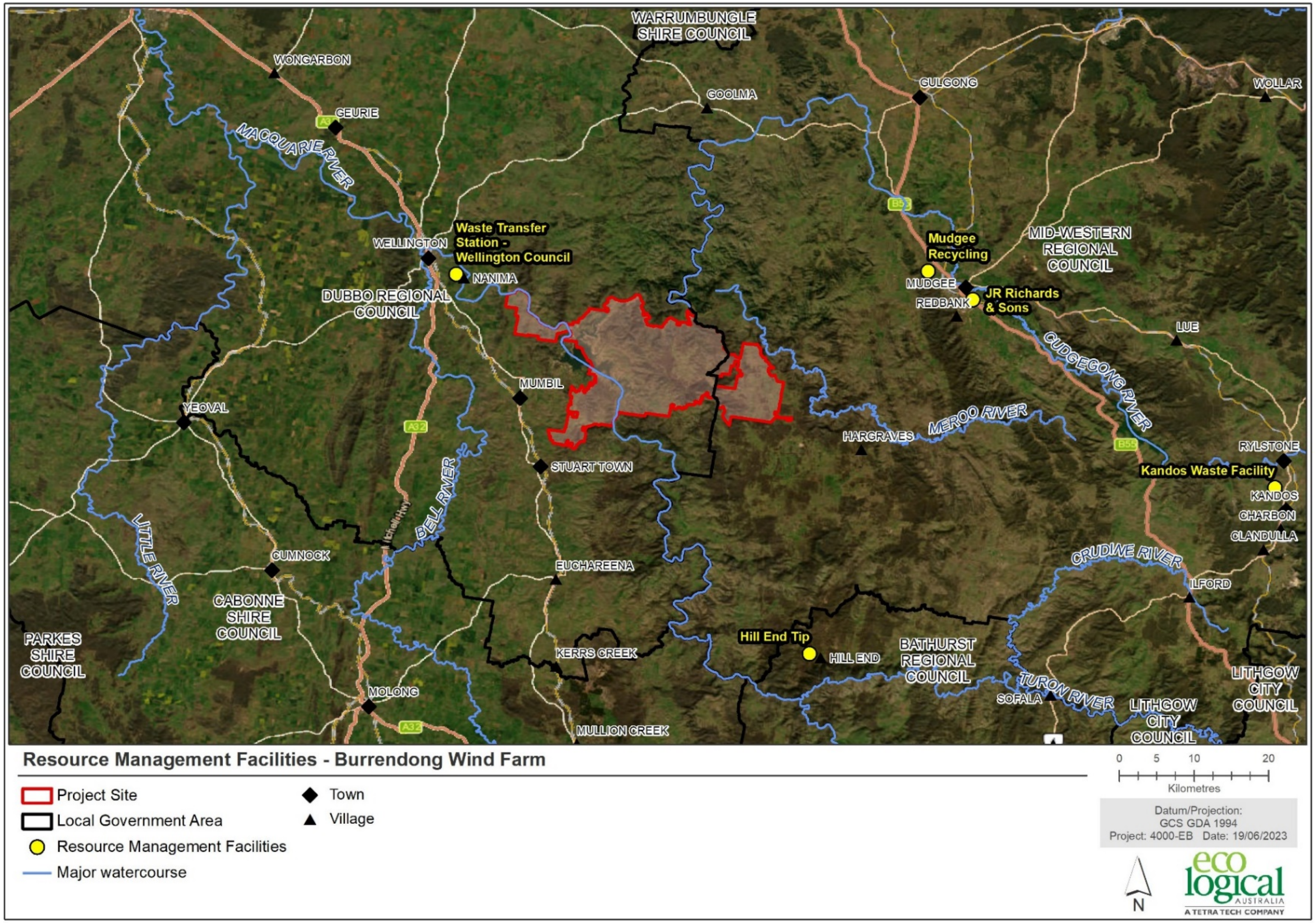


Figure 6-69: Resource and Waste Management Facilities in proximity to the Project Site

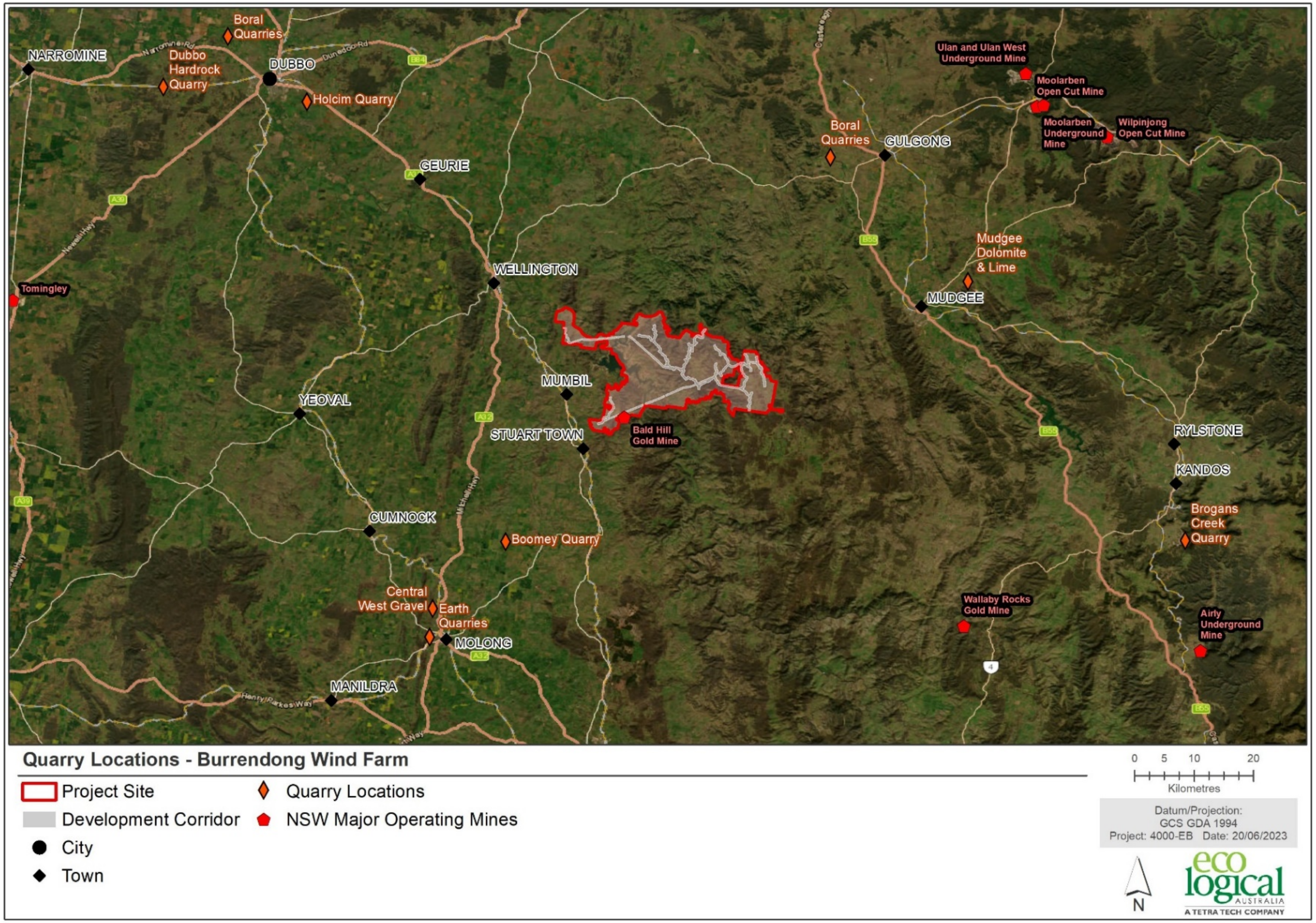


Figure 6-70: Quarries within 150 km of the Project Site

6.12.2. Potential Impacts

6.12.2.1. Resource Use

Resource requirements that are typical for a new development site, include several materials during construction, including:

- Aggregate, sand, asphalt, and base course for access tracks, crane hardstand areas, site buildings and infrastructure.
- Concrete for WTG foundations and site building slabs and foundations.
- Water for dust control, plant wash, and concrete.

It is assumed that 50% of raw materials needed for the construction of roads, hardstands, and foundations (sand, gravel, etc.) will be sourced from the Project Site, predominantly coming from the WTG foundation excavation. The other 50% of raw materials will be imported from several suitable quarries as outlined in Table 6-102 where possible.

Cement for foundations will be sourced by the civil construction company selected to construct the Project by the Proponent. Resources would be sourced locally where practicable. Aggregate and sand will also be sourced locally and as close to the Project Site as possible, including reusing material excavated from the foundations and earthworks onsite. The supply of materials required to produce cement are widely accessible throughout the region and NSW and are not currently limited or restricted. The quantities required by the Project will be determined during the detailed design stage. However, should the amount required outstrip the available resources in a local context, it is anticipated that the civil construction company engaged will be able to easily source the required quantities from alternate sources. This may include from larger regional centres such as Dubbo and Mudgee.

CONSTRUCTION

Aggregate

Resources will be sourced locally where possible; this includes reusing excavated materials. To reuse excavated materials, a rock crusher will be used to create rock of appropriate sizes and shapes for reuse. The daily rock crushing capacity required will be confirmed following a pre-construction geotechnical assessment on the Project Site to determine the extent of suitable construction materials available. Schedule 1 of the POEO Act requires a license to undertake an activity when triggered under the Act. With regards to aggregate, the POEO Act states that a licence is required if rock crushing activities process more than 150 tonnes of material per day. In accordance with Section 4.42 of the EP&A Act, an authorisation of an EPL cannot be refused if it is necessary for carrying out SSD that is authorised by a Development Consent under Division 4.7 of the Act and is to be substantially consistent with the consent.

Topsoil cleared during the construction phase will be stockpiled and used for rehabilitation, and rock excavated from WTG foundation preparations used for road base, back fill for foundations and/or erosion control purposes as far as practicable.

Aggregate and sand will be sourced as close to the Project Site as possible to minimise transportation costs (Table 6-102). The Project is unlikely to place any significant pressure on the availability of these resources due to the proliferation of quarries in the region indicating a well-stocked resource. However, it is considered that the use of local quarries will be the most cost-effective approach due to reduce haulage costs. If it is decided to pursue the establishment of a local quarry, then this will be separately assessed and approved under the relevant planning instrument.

Concrete Batching

Due to the isolated nature of the Project Site and the scale of the Project, a concrete batching plant will be required to supply concrete for the roads, WTG foundations buildings and other facilities. The plant will require approximately 0.5 ha of land to house cement, admixture silos, hoppers, concrete truck loading hardstands, and stockpiles. Following detailed geotechnical site investigations and the final Project layout, accurate estimates of materials to be processed by these facilities will be calculated. If the extraction and processing thresholds used in concrete batching exceed Schedule 1 of the POEO Act, an EPL will be obtained from the EPA for the operation of rock crushing or concrete batching facilities.

Table 6-103 identifies components of the Project that require resources for the development of hardstand surfaces. The exact resource requirements of these components will be calculated when the detailed design is finalised, and geotechnical site investigations have been completed. Procurement of resources required for the Project will be determined during the post-Development Consent tender, contractor selection, optimisation, detailed design and procurement processes and the construction period.

Table 6-103: Project components and hardstand requirements

Project Components and Infrastructure	Approximate Dimensions[10]	Area of Hardstand per Component	Quantity	Depth of Hardstand	Total Volume
		Concrete			
WTG foundations (excavation size)	30 x 30 m	0.003 ha	70	2 m	126,000 m^3
Compound	250 x 250 m	0.25 ha	1	400 mm	25,000 m^3
Site compound and office	300 x 200 m	0.06 ha	2	400 mm	48,000 m^3
Substations	Up to 250 x 250 m	0.25 ha	Up to 2	400 mm	Up to 150,000 m^3
O&M Compounds	150 x 70 m	0.01 ha	1	400 mm	4,000 m^3
Overhead transmission lines (high voltage)	TBC	-	N/A	-	-
Overhead transmission lines (medium to low voltage)	TBC	-	N/A	-	-
Permanent Meteorological Masts	Six footings of 1 m^2 per mast	<0.01 ha	3	200 mm	1.2 m^3

[10] Dimensions stated are approximate, subject to post-Development Consent, tender, contractor selection, optimisation, detailed design, and procurement process.

Project Components and Infrastructure	Approximate Dimensions[10]	Area of Hardstand per Component	Quantity	Depth of Hardstand	Total Volume
(concrete footings for mast and guy wires)					
Concrete (or asphalt) batching plants	50 x 100 m	0.05 ha	3	400 mm	6,000 m^3
Temporary Meteorological Masts (concrete footing for mast and guy wires)	Twelve footings of 1 m^2 per mast	<0.01 ha	12	200 mm	2.4 m^3
		Road Base			
Rock crushing facilities	50 m x 100 m x 400 mm	0.5 ha	3	400 mm	6,000 m^3
Hardstands	70 x 75 m	0.0075 ha	70	400 mm	136,500 m^3
		Asphalt			
Internal Roads and drainage	9 m x 79 km	81 ha	N/A	300 mm	171,400 m^3

The approximate composition for the generation of WTG foundation concrete is outlined in Table 6-104 including the approximate quantity of resources required to construct 70 WTG foundations. The concrete mix below has a mix ratio of 1:1:5:3 (Cement: Sand: Aggregate: Water) in accordance with Australian Standard AS 1379 – Specification and supply of concrete. The total required resources to construct 70 WTG foundations is 126,000 m^3 of concrete, sand, aggregate and water collectively.

Table 6-104: Concrete material required for construction of WTG (Australian Standard AS1379:1997)

Component	Approximate Composition by Mass	Amount required for 1,800m^3 WTG foundation (30 m x 30 m x 2 m)	Quantity required for 70 WTG
Cement	13%	234 m^3	15,210 m^3
Sand	34%	612 m^3	39,780 m^3
Aggregate	46%	828 m^3	53,820 m^3
Water	7%	126 m^3	8,190 m^3
TOTAL	**100%**	**1800 m^3**	**117,000 m^3**

WATER

Water resources are required during construction for dust control, plant washing and the production of concrete. The production of concrete is the most water intensive component of construction and requires water that is relatively free of impurities to reduce the potential for adverse reactions with the cement. Therefore, water required for concrete batching will need to be of quality like that of potable water. The water requirements of the Project will be met in accordance with WM Act by sourcing water from within the locality, where practical, and from local suppliers. If it is not practicable to source water locally, then it will be brought to the Project Site by licensed external water suppliers under contract to the Project. Potable water will be sourced from the municipal water supply and transported to the site using road registered water trucks. Water that does not need to be of potable quality will be sourced from water storages in the region and transported to the Project Site using road registered water trucks.

It is estimated that in the order of 140 – 160 mega litres (ML) of water would be required by the Project to produce the quantity of concrete required for gravity foundations (which can be considered the maximum amount of water required for use in concrete batching) as well as water use for road construction and dust suppression activities during construction. This estimated volume would service all new and upgraded on-site internal road construction and dust suppression activities, including those associated with the unsealed public roads. The water volumes provided above are reasonable regarding the types of activities proposed, however they are estimates and not limits. Prevailing weather conditions during the period of construction, temperature, will affect the volume of water required.

OPERATION

During the operational life of the Project, the resources used would largely be associated with maintenance activities and the use of machinery and vehicles. This may include the small volumes of water and non-renewable resources such as hydrocarbon fuels and oils for machinery and vehicles. Due to the low volumes of these resource types, the Project is unlikely to place any significant pressure on the availability of these resources. Otherwise, no additional resources are required for the ongoing operation of the Project.

As wind is a source of energy which is non-polluting and renewable, the Project is designed and intended to create power without the use of fossil fuels or other resources as operational fuel.

DECOMMISSIONING

The primary resources required to support the decommissioning phase of the Project would be the use of machinery and vehicles associated with the activities of removing the WTGs and ancillary Infrastructure. While this may require the use of water and non-renewable resources for machinery and vehicles, the amounts required would be relatively minor.

If the Proponent decides to repower the site after 30 years, many of the resources previously used will be reused by repowering development.

6.12.2.2. Waste

Under the waste definitions in the POEO Act, most of the waste generated during the construction phase would be classified as general solid waste, either putrescible or non-putrescible. Staff facilities such as transportable amenities buildings at the site would also produce sanitary wastes defined as general solid wastes (putrescible) is accordance with the relevant waste definitions under the POEO Act. Waste streams generated during the construction of the Project would be managed using the waste hierarchy approach, which involves the following:

- **Avoidance:** Including action to reduce the amount of waste generated by households, industry, and all levels of government.
- **Resource Recovery:** Including re-use, recycling, reprocessing and energy recovery, consistent with the most efficient use of the recovered resources.

- **Disposal:** Including management of all disposal options in the most environmentally responsible manner.

There are several locations for off-site recycling and disposal of construction waste generated by the Project. These are presented in Table 6-101. DRCs waste management facilities at Dubbo and Wellington are equipped to accept mixed commercial and industrial waste, including general waste, green waste, recyclables, oil, and batteries. DRC and MWRCs waste management facilities would be suitable for recycling and disposing of most of the waste generated during the construction phase of the Project.

Specific resource recovery facilities and waste collection contractors would be selected during the detailed design and contract development stages of the Project and documented in the EMP, OEMP, and DMP. Sanitary waste from temporary staff facilities would be held onsite in an appropriate facility and disposed by a suitable liquid waste contractor.

Waste streams during the operation of the Project would be limited to minor quantities of putrescible waste from staff amenities, redundant equipment, and general waste from maintenance workers. These would be disposed of via DRC and MWRC waste and recycling centres as well as suitably equipped waste contractors. Specific resource recovery facilities and waste collection contractors would be selected during the detailed design and contract development stages of the Project and documented in the EMP, OEMP, and DMP. Sanitary waste from temporary staff facilities would be held onsite in an appropriate facility and disposed by a suitable liquid waste contractor.

The classification and description of the potential waste types likely to be generated by each phase of the Project are summarised in Table 6-105 below.

CONSTRUCTION

The construction period of the Project is going to result in the largest contribution of waste, most of which will be required to be disposed of off-site. While the Bald Hill Landfill has indicated that they accept commercial waste, other waste operators are likely to struggle to service the waste as the area surrounding the Project Site is not well serviced by private waste contractors. The Project is anticipated to add additional waste into the local waste stream that largely rejects commercial waste, with the estimated tonnes of additional waste to be determined during the detailed design phase.

The Waste Classification Guidelines: Part 1 Classifying Waste (NSW EPA, 2014) provide direction on the appropriate classification of waste, specifying requirements for management, transportation, and disposal of each waste category. Should waste be found to be unsuitable for reuse or recycling, disposal methods would be selected based on the classification of the waste material in accordance with the Waste Classification Guidelines. The types and classification of waste streams generated by the Project would vary throughout the construction phase; however, mostly comprises those listed below in Table 6-106.

Under the waste definitions in the POEO Act, most of the waste generated during the construction phase would be classified as general solid waste, either putrescible or non-putrescible. Putrescible waste is solid waste that contains organic materials that can be decomposed by microorganisms such as household waste, food, and animal waste. Non-putrescible waste is not subject to decay and include waste such as garden waste, virgin excavated materials, building and demolition waste. Staff facilities such as transportable amenities buildings at the site would also produce sanitary wastes defined as general solid wastes (putrescible) in accordance with the relevant waste definitions under the POEO Act.

OPERATION

In general, the potential impacts associated with waste generation and management during the operational phase would be like those for construction, albeit at a much smaller scale. Waste streams during the operation of the Project would be limited to minor quantities of putrescible waste from staff amenities, redundant equipment, and general waste from maintenance workers. These would be disposed of via Mid-Western Regional Council waste and recycling centres as well as suitably equipped waste contractors.

No waste streams would be associated with the generation of electricity using WTGs. Some materials such as fuels and lubricants, redundant equipment and metals may require very infrequent replacement over the operational life of the Project.

DECOMMISSIONING

At the end of the operational life of the Project, all above ground infrastructure will be dismantled and removed from the Project Site and recycled in accordance with best practice at the time. This is discussed below. Some components will be left in-situ such as the WTG tower bases. These would be cut back to below ground level allowing ploughing over or topsoil to be built up over the footing to achieve a similar result. The land will be returned to near prior condition. A compressor and rock crusher may be required to carry out the cutting work of the foundations and footings. Underground cables (inert and stable) at a depth greater than 500 mm would be left in-situ to avoid unnecessary ground disturbance. Essential connection infrastructure will also be retained.

Solid wastes will be generated by decommissioning activities (non-putrescibles, putrescibles), although to a lesser degree compared to the construction phase. Solid wastes include packaging, excess building materials, general refuse, and other non-putrescible wastes will be disposed of using waste management facilities outlined above.

All materials will be recycled wherever possible. If materials cannot be recycled, they will be disposed of at the appropriate waste management facility. It is important to note that the recycling of WTGs is an evolving space with research and experimentation occurring across the world to find ways to recycle WTG components at the end of its life. Currently, the biggest barrier to zero waste WTGs are the WTG blades that are a mix of epoxies and composite materials that are typically difficult to separate at the decommissioning stage. WTG manufacturer Siemens states that 85% of WTGs are already recyclable (Vorrath, 2021), while the Clean Energy Council notes that between 85-94% of WTGs (by mass) are recyclable and can be recycled in Australia (CEC, 2023). The blades are the primary component that is difficult to recycle as they are made from carbon fibre and fibre glass. Traditionally, the fibre glass and carbon fibre elements used in WTG construction have made recycling difficult and cost prohibitive. However, there is research focused on designing new blades that have materials that are easier to recycle, methods to make recycling of existing materials cheaper and less resource intensive, and repurposing (Vorrath, 2021). The Danish WTG manufacturer LM Wind announced that by 2030, they will begin producing zero waste WTGs, in part to further reduce the CO^2 emissions resulting from the WTG supply chain (Hill, 2021). Similarly, WTG manufacturer, RecyclableBlade, announced a further step in their path towards fully recyclable WTGs by 2040. This will be done through their novel approach to separating the resin which has traditionally made it difficult to fully recycle WTGs, allowing them to utilise the reclaimed parts (Vorrath, 2021). Furthermore, GE is developing a recyclable blade through Project ZEBRA (CEC, 2023). The overarching element to the novel approaches to recycle composite sections of WTGs is to develop methods for resins that can be separated from other components.

Siemens is currently testing recyclable blades in windfarms throughout Europe; however, they are not yet in the market (Thomas, 2021). The Proponent will investigate the feasibility of using these products when procuring the WTG components. Additionally, the Proponent will continue to stay up to date with industry innovations in the production and recycling of WTG components such as:

- Novel Turbine Construction – Emerging technology in blade production using thermoplastics that are more recyclable, stronger, can be made longer and lighter and potentially produced on site reducing transportation costs and emissions.
- Chemical Resource Recovery – reclamation of raw materials, fibre, and epoxy, to be used again in construction of new WTG components.
- Mechanical Recycling – the mechanical grinding of fibreglass blades to produce material used in cement production. A study found that this option was cheaper than landfilling old blades and other methods of recycling (Fonte and Xydis, 2021).
- Reuse – demand for used elements continues to develop across several areas, with Vestas using pre-owned rotor upgrades on projects in 22 countries (CEC, 2023).
- Repurpose – Components have been repurposed for new construction projects such as playgrounds and bridges (Belton, 2020) as well as in alternative production methods such as a cement additive.

The Proponent will continue to research these innovations and create a decommissioning plan that will use the most up to date technology and methods to minimise waste and maximise reuse and recycling.

Table 6-105: Potential Waste Descriptions

Waste Types	Project Phase	Waste Classification	Details
Hydrocarbons	C, D	Liquid Waste	Used lubricants, etc.
Construction/ structural Waste	C, D	General Solid Waste (non-putrescible)	Waste from construction would include excess concrete, metal, timber, fittings, and packaging.
Domestic/ office waste	C, O, D	General Solid Waste (putrescible and non-putrescible)	Waste would consist of everyday items such as paper, food, aluminium cans, plastics, packaging, and other material generated by onsite contractors.
Green Waste	C	General Solid Waste (non-putrescible)	Cleared vegetation.

Waste Types	Project Phase	Waste Classification	Details
Liquid waste	C, D	Liquid Waste	Oil, paint, lubricants, glue etc.
Sewage	C, O, D	Liquid Waste General Solid Waste (putrescible)	Effluent from ablutions and office buildings.
Chemical/ hydrocarbon containers	C, O, D	General Solid Waste (non-putrescible)	Fuel and lubricant storage. Herbicides and pesticide storage.
C – Construction, O – Operation, D – Decommissioning # as defined in Clause 49 of Schedule 1 of the POEO Act			

Managed effectively, in line with the mitigation measures described in the section below, the generation of waste because of the Project would not cause any significant adverse impacts and adequate arrangements can be made throughout the various stages of the Project to ensure resource reuse and waste disposal complies with the relevant legislative requirements, including the EPA Waste Classification Guidelines.

Table 6-106: Anticipated construction waste types

Activity	Waste streams produced	Classification	Waste management strategy
Site establishment & enabling works	Green waste from removal of vegetation including trees, shrubs and groundcover that are unable to be mulched and reused within the Project.	General Solid Waste (putrescible)	Minimise areas of vegetation to be removed through site design.
Operation of construction machinery	Waste from operation and maintenance of construction vehicles and machinery including adhesives, lubricants, waste fuels and oils, engine coolant, batteries, hoses, and tyres.	Hazardous waste, Special waste & Liquid waste	Waste oil and filters from operations activities would be stored in recycling bins, collected by an authorised contractor, and disposed off-site at a dedicated recycling facility. Also, batteries to be collected and recycled by a qualified handler.
Earthworks (cut & fill)	Excavated wastes (spoil), such as soil and rock, primarily from tunnelling and cutting including virgin excavated natural material (VENM).	General solid waste (non-putrescible)	Minimise excavation and fill requirements by site design and use existing internal access tracks where possible.
Construction of permanent operational infrastructure (WTGs)	General construction waste such as timber formwork, scrap metal, steel, concrete, plasterboards, and packaging material (crates, pallets, cartons, plastics and wrapping materials).	General solid waste (non-putrescible)	All general construction materials that are potentially recyclable should be disassembled to maximise further reuse (if feasible) and recycling. Waste materials should be clearly separated and stored on-site, monitored and maintained by the site's environment/waste manager.
Construction of permanent operational infrastructure (road works and construction of footings)	Surplus construction material and general site reinstatement waste such as fencing, sediment, concrete, steel, formwork and sandbags.	General solid waste (non-putrescible)	Surplus construction materials associated with road surfacing or footings (WTGs & crane hardstand areas) may be transferred to other parts of the Project for use or stored by the contractor for future use. In the second instance, surplus construction materials may be recycled where possible. Any surplus materials associated with establishing foundations (including road works) should avoid being sent to landfill.
Office staff and contractors (temporary)	General wastes from site offices such as putrescibles, paper, cardboard, plastics, glass and printer cartridges.	General solid waste (non-putrescible) and General solid waste (putrescible)	All waste and recycling generated by the site offices should be source-separated into the following dedicated bins: • General waste • Organic waste • Paper/cardboard • Recyclable plastics, glass, and metals • Batteries

Activity	Waste streams produced	Classification	Waste management strategy
			• Toner/ cartridges
Construction of the substation and overhead powerlines	Surplus construction material and general site reinstatement waste such as metal cable offcuts, scrap metal, fencing, sediment, concrete, formwork, and sandbags.	General solid waste (non-putrescible) and General solid waste (putrescible)	Surplus construction materials associated with the substation and overhead powerlines may be transferred to other sites for use or stored by the contractor for future use. In the second instance, surplus construction materials may be recycled where possible. Surplus materials should avoid being sent to landfill.
Staff amenities (kitchen & bathroom)	Bio wastes from onsite sewerage collection systems within temporary staff facilities.	Liquid waste	Sewerage obtained from within temporary staff facilities would be collected and disposed by an appropriately experienced liquid waste contractor. Depending on the arrangements of the nominated waste contractor, sewerage may be disposed at one of Dubbo Regional Council or Mid-Western Regional Council sewerage treatment facilities.

6.12.3. Mitigation Measures

Table 6-107 outlines the proposed measures to mitigate potential waste impacts.

Table 6-107: Mitigation Measures for Resource and Waste Management

Environmental Impact	Mitigation Measure	Reference Code
Resource Use	Excavated materials will be reused where possible throughout the Project, including: • Topsoil cleared during the construction phase will be used for rehabilitation. • Rock excavated from WTG foundation preparations will be used for road base, backfill for foundations and/or erosion control purposes where practicable. • Sediment recovered from erosion and sediment control devise will be reused onsite as general fill material or it will be incorporated within landscaping materials where possible.	RW001
	Aggregate and sand will be sourced as close to the Project site as possible to minimise the use of resources associated to transporting materials.	RW002
	Opportunities to use low emission construction materials, such as the use of bio-fuels or bio-fuel blends in construction plant and equipment, recycled aggregates in road pavement and surfacing, steel with recycled content, and cement replacement materials, will be investigated and incorporated where feasible and cost effective.	RW003
	Construction plant and equipment will be operated and maintained to maximise efficiency and reduce emissions, with construction planning used to minimise vehicle wait times and idling onsite and machinery turned off when not in use.	RW004
Waste	The NSW Governments Waste Management Hierarchy of "avoid-reduce-reuse- recycle-dispose" will be followed as the framework of waste management throughout the project.	RW005
	The reuse and/or recycling of waste materials generated on site shall be maximised as far as practicable, to minimise the need for treatment or disposal of those materials offsite.	RW006
	All waste material generated on-site will be dealt with in accordance with the POEO Act and Waste Classification Guidelines Part 1: Classifying Waste (EPA 2014), or any superseding.	RW007
	Wastes that are unable to be reused or recycled will be disposed of offsite at a licensed waste management facility, or premises lawfully permitted to accept the materials following classification.	RW008
	A Quantity Surveyor accredited Australian Institute of Quantity Surveyors (AIQS) must be engaged to estimate materials required for construction. Materials procurement will be planned and managed to avoid the over-ordering of products and minimise excess packaging is to be carried out.	RW009
	Regular visual inspections will be conducted to ensure that work sites are kept tidy and to identify opportunities for reuse and recycling.	RW010
	At site compounds, offices and ablutions waste bins will be provided for the recycling of paper, plastic, glass, and other re-useable materials.	RW011
	Hazardous waste and sewerage will be managed by appropriately qualified and licensed contractors.	RW012
	Classify wastes in accordance with the NSW EPA Waste Classification Guidelines – Part 1: classifying waste (EPA 2014) and addendum (EPA 2016).	RW013
	All waste must be handled and stored on site in accordance with its classification and disposed of at appropriately licensed waste facilities.	RW014

6.13 Social

A Social Impact Assessment has been prepared by Ethos Urban (2023a, Appendix S). The SIA has been undertaken in accordance with the requirements of the SEARs, which include:

- *Assessing the social impacts in accordance with the Social Impact Assessment Guideline (DPE, 2023b) and consideration of construction workforce accommodation.*

Assessment Overview

The Social Impact Assessment was undertaken by Ethos Urban (2023a) to assess the existing social environment around the Project Site as well as the potential impacts of the Project to social factors. They included identifying and scoping social impacts, such as the social locality, community characteristics and potential social impacts of the Project on different groups. It required defining the social locality, demographic profile and an understanding of local social issues and trends. The SIA used data from the Australian Bureau of Statistics, other technical assessments, and stakeholder analysis to identify those with an interest in the Project and/or could be impacted by its construction, operation, or decommissioning.

Moir's (MLA, 2023) survey informed the SIA by identifying the key factors relevant to the landscape. The survey found that community and people were considered the most important factors in the rural landscape. Impacts to farming and agriculture and landforms and terrain were also important. The SIA uses this information to assess the social perception of these key factors and related impacts.

The Project is anticipated to have several social benefits to local communities as well as the region more broadly. Positive impacts of the Project includes fulltime and parttime residents receiving financial benefits by hosting turbines, which leads to the diversification of income for host landholders that can assist them through periods of drought and other economic hardships. A Community Benefit Sharing Program will be established to inject income directly into communities, benefiting the locality for the operating period of the Project. Mobile and road infrastructure is anticipated to be upgraded which will provide benefits to local road users and regional communities. Additionally, workers in the primary and secondary social localities will see an increase in employment opportunities.

Mitigation measures have been proposed to mitigate potential impacts of the Project in 6.13.3.

6.13.1. Existing Environment

6.13.1.1. Social Locality

The areas of social influence have been determined for the Project based on considerations of:

- The construction activities and operational uses of the Project.
- The likely scale and extent of potential direct and indirect impacts and benefits of the Project on the social factors identified in the SIA Guideline (DPE, 2023b), including indirect impacts that are generally less tangible and more commonly relate to matters such as community values, identity, and sense of connection to place.
- Cumulative impacts that may impact affected communities because of other transport, construction.
- The potentially affected built or natural features that have social value or importance located on or near the Project Site, and the social characteristics of the areas likely to be affected by the Project, as informed by the social baseline study and other technical assessments.
- The community and stakeholder groups that would be most likely affected by the direct and indirect impacts, based on stakeholder and community engagement activities, and other available information sources.

Two 'social localities' are referred to, to define the areas subject to assessment – the primary social locality, and secondary social locality. Table 6-108 defines the social locality for the Project Site and surrounding areas as well as the broader regional context, as shown in Figure 6-71 and Figure 6-72, respectively.

Table 6-108: Social locality definitions (Ethos Urban, 2023a)

Study Area	Relevance to the Social Impact Assessment	Definition in the Social Impact Assessment (Ethos Urban, 2023a)
Social Locality (Local Context)	Likely to be localised social impacts relating to the immediate surrounds of the Project Site, for example impacts associated with the construction of new buildings (i.e., amenity values, access, noise, air quality). Longer term impacts such as potential noise, light, traffic and/or increased activity in the area may occur within the proximity to the Project Site.	Defined as 5 km from the Project Site boundary. This area recognises that residents within this zone may be highly impacted by construction and operation. For the purposes of cumulative impacts, a zone of up to 8 km from the Project Site has been considered as the primary social locality.
Social Locality (Regional Context)	Understand the broader impacts and benefits of the Project will likely have on the surrounding community and region.	A secondary social locality has been considered necessary due to the broader impacts and benefits that the Project will likely have on the surrounding regional community. The area is defined as the Dubbo Regional and Mid-Western LGAs. Falling within the Central West and Orana REZ, communities living within these LGAs are likely to experience impacts associated with operation of the Project. This may include changes to the viability of dominant industries and job concentration which is likely to occur over the next decade because of the shift from fossil-fuelled to renewable energy. The Central-West Orana REZ has also been referenced with regards to cumulative impacts, though the secondary social locality is the focus when considering cumulative impacts.

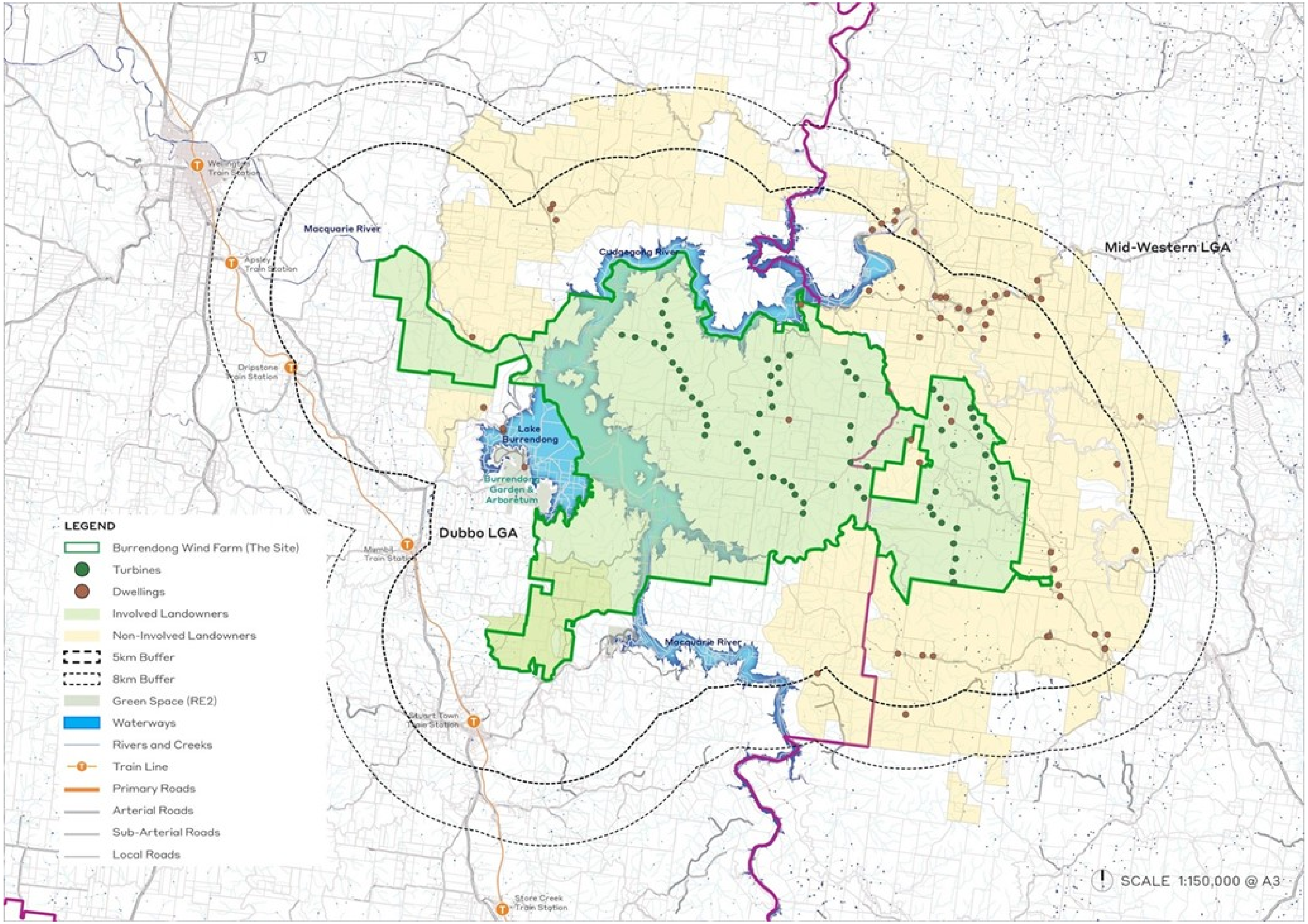


Figure 6-71: Primary social locality (Ethos Urban, 2023a)

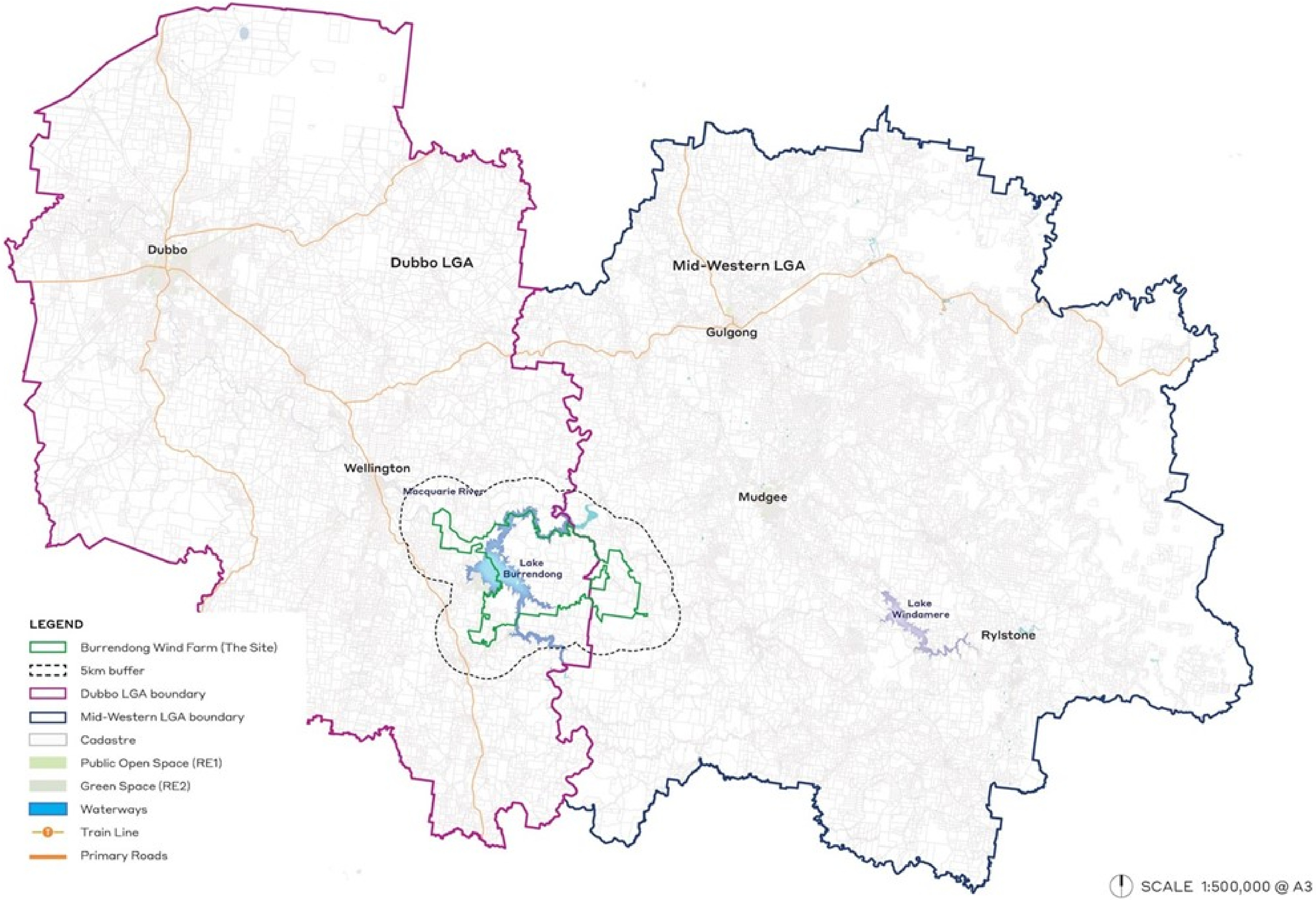


Figure 6-72: Secondary social locality (Ethos Urban, 2023a)

6.13.1.2. Demographic Profile

The latest ABS Census data (2021 ABS Census of Population and Housing) provides an overview of the demographic profile of the identified social locality and compares it to the Regional NSW benchmarks (excluding Greater Sydney). The key findings regarding relevant social indicators include:

- **Age Structure:** The primary social locality contains a higher median age (49.3) than the secondary social locality (38.4) and the Regional NSW (42.4). This is driven by a high proportion of 50-59-year-olds, and 60-69-year-olds, which represent 17.5% and 21.1% of the primary social locality population, respectively.
- **Education:** A lower proportion of residents aged over 15 in the primary social locality have completed Year 12 – only 35.7%. This is low when compared to the proportion of the secondary social locality (47%) and Regional NSW (48.4%).
- **Median Income:** Primary social locality households earn significantly lower when compared to the secondary social locality and Regional NSW, with a median household income of $55,530. The median household income is $81,380 in the secondary social locality and $75,280 in Regional NSW.
- **Cultural Diversity:** There is low cultural diversity in the primary social locality and secondary social locality, with 92.7% of the primary social locality and 89.9% of the secondary social locality born in Australia. This is comparable to Regional NSW, of which 88.5% of the population were born in Australia. In the primary social locality, the top countries of birth (other than Australia) are England, New Zealand, and Ireland.
- **Household Composition:** The most predominant household type in the primary social locality is family households, accounting for 61.2% of total households. This is comparable to the secondary social locality and Regional NSW, which contain 69.2% and 68.8% family households, respectively. There is a slightly higher proportion of lone person households in the primary social locality (35.1%), compared to the secondary social locality (27.6%) and Regional NSW (28%).
- **Dwelling Structure:** Dwellings are mostly separate houses in the primary social locality, accounting for 97.5% of occupied private dwellings. This is a higher proportion than seen in the secondary social locality (87.6%) and Regional NSW (82.9%).
- **Tenure Type**: There is a high share of homes which are owned outright in the primary social locality, accounting for 55.2% of occupied private dwellings. This is higher than the share of homes owned outright in the secondary social locality (34%) and Regional NSW (38.9%). There is also a significant proportion of homes owned with a mortgage in the primary social locality (33%).

6.13.1.3. Population Forecasts

The population forecasts and estimates presented in Table 6-109 show that in 2022, the primary social locality had an estimated resident population (ERP) of 1,220 with a projected increase of 70 people by 2036. In 2022, the ERP of the secondary social locality was 81,710 people, with a projected increase of 10,200 by 2036. The population growth rate forecast for the primary social locality is lower than the Regional NSW benchmark, while the secondary social locality is slightly higher.

Table 6-109: Population projections for the social localities (Ethos Urban, 2023a)

Population Area	2011	2016	2022	2026	2031	2036	2011-2022	2022-2036
				Population				
PSL	1,180	1,180	1,220	1,240	1,260	1,290	+40	+70
SSL	72,180	76,040	81,710	84,530	88,280	91,910	+9,530	+10,200
				Average Annual Growth (no.)				
PSL	-	+0	+10	+10	+0	+10	+0	+10
				Average Annual Growth (%)				
PSL	-	0.0%	0.6%	0.4%	0.3%	0.5%	0.3%	0.4
SSL	-	1.0%	0.12%	0.9%	0.9%	0.8%	1.1%	0.8%
				Benchmark				
Regional NSW	2,609,580	2,707,940	2,859,300	2,941,190	3,047,190	3,172,490	+249,720	+313,190
Average Annual Growth	-	+19,672	+25,227	+20,473	+21,200	+25,060	+22,700	+22,370
Growth Rate	-	0.7%	0.9%	0.7%	0.7%	0.8%	0.8%	0.7%

PSL = PRIMARY SOCIAL LOCALITY; SSL = SECONDARY SOCIAL LOCALITY

6.13.1.4. Local Social Issues and Trends

CLIMATE CHANGE AND AUSTRALIA'S COMMITMENTS

The impacts of climate change have been increasingly evident and experienced in Australia. The local government areas of Dubbo and Mid-Western are not unaffected by this event. Historical records indicate an upward trend in average temperatures, and a downward trend in average rainfall (GRDC, 2019). The Central West and Orana Regional Plan recognises that "climate change is likely to result in lower rainfall, higher temperatures, and prolonged dry periods. This may cause more frequent and more intense weather events, which will impact ecosystems, agricultural productivity and the health and wellbeing of rural communities" (Central West and Orana Regional Plan 2041).

The Central West and Orana Region continues to be vulnerable to the impacts of climate change compared to other areas in the state and entire country. Extreme weather events, including heatwaves, drought, and flooding, are projected to become more common if temperatures continue to rise at the current rate. As the second largest region in NSW, Central West and Orana are integral to domestic and international supply chains, providing essential agribusiness, mining, and renewable energy production. This economic activity is threatened by climate change, which has the potential to significantly disrupt existing patterns of production. It is a regional priority to find solutions to climate change and mitigate its adverse impacts on communities and the economy (Figure 6-73).

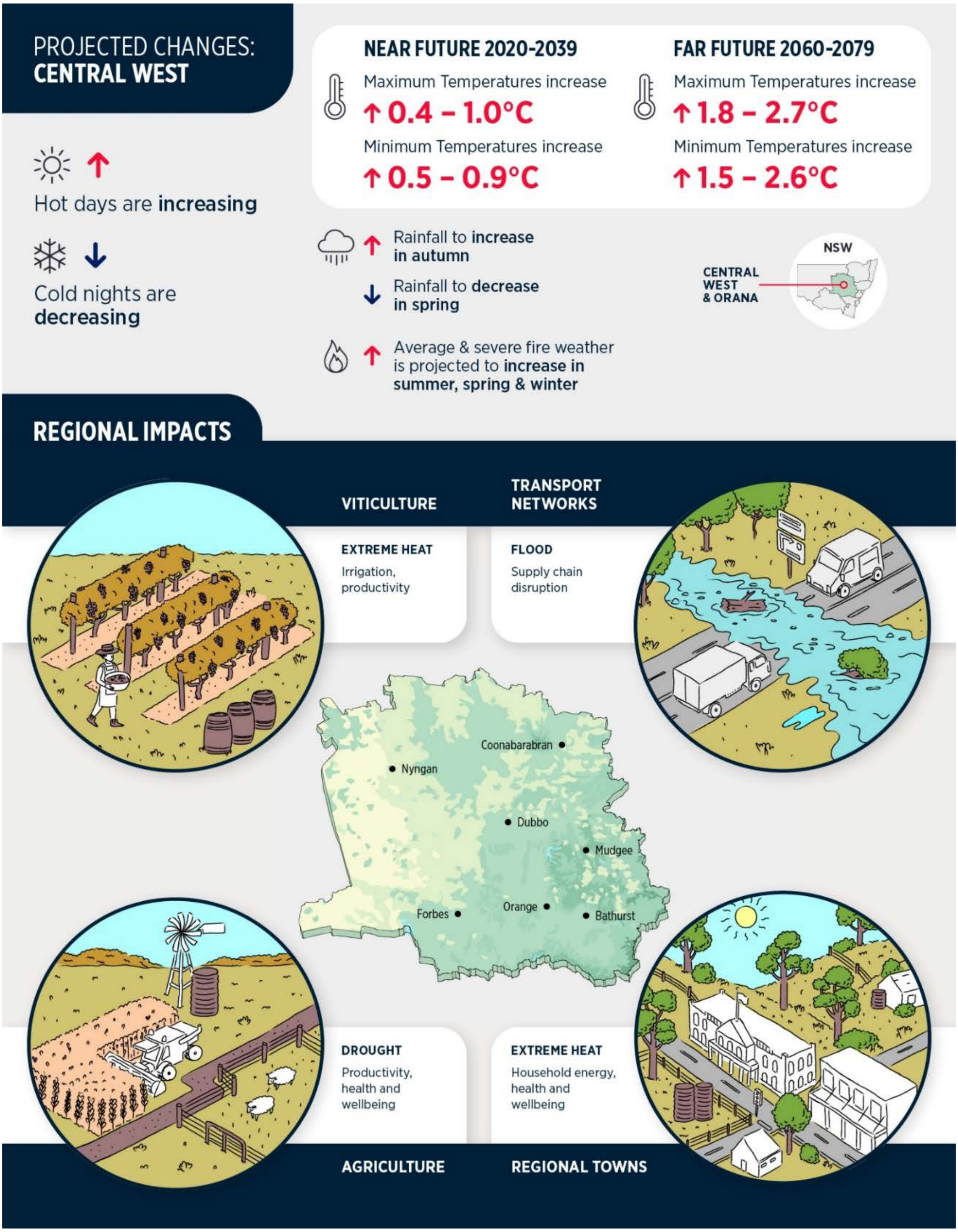


Figure 6-73: The effects of climate change on the Central West and Orana region (Ethos Urban, 2023a)

DEVELOPMENT OF THE CENTRAL WEST ORANA RENEWABLE ENERGY ZONE

DPE established the REZ in the Central West and Orana Region in late 2019, which is key to ensuring more affordable, sustainable, and reliable electricity sources for NSW and will assist in revolutionising energy production across the state. The NSW Government is seeking to attract 3,000 MW of investment to accelerate the state's efforts to attract cheap wind to replace NSW's ageing coal-fired power stations (Parkinson, 2019). The Central West and Orana REZ aims to produce enough energy to power up to 1.3 million homes each year.

NSW's REZs will be led by the EnergyCo, who will coordinate all activities associated with renewable energy production in these regions, including planning and community engagement. It is expected that the REZ will deliver over $5 billion of investment, and approximately 3,900 construction jobs to the Central West and Orana Region.

IMPACT OF WIND FARMS ON RURAL COMMUNITIES

As wind farms and renewable energy production in general become more common in Australia, it is important to consider the impacts of wind farm development on communities. Attempts to link wind farms to poorer health for those living in proximity have been made by the groups that oppose them. However, research has found that direct health effects of living near WTGs were ambiguous and largely disproven. A greater risk to health is likely to stem from the psychological stress of negative perceptions surrounding wind farms. Changes to visual amenity appear to be one of the most significant impacts of wind farms, due to their highly visible nature which tends to disrupt natural landscapes. This impact appears to be highly dependable on overall attitudes toward wind farms, with equally positive and negative responses.

A literature review by the National Health and Medical Research Council (NHMRC, 2015) concluded that noise exposure levels from Australian wind farms are unlikely to cause any significant direct issues, stating that "with the exception of annoyance, sleep quality, and quality of life – which are possibly related – there was no consistent association between adverse health effects and estimated noise from wind turbines" (NHMRC, 2015). However, while limited, sleep disturbance and annoyance can have significant impacts on quality of life if not appropriately mitigated.

Wind farms can also have considerable social and economic impacts on rural communities. This type of renewable energy development generates a significant number of jobs during construction, which is likely to positively impact communities through local job creation and increased business for related industries in proximity. Payment schemes are often common when wind farms acquire private parcels of land, which can bring both positive and negative impacts – while the landowners receive positive compensation, it can bring about conflict between landowners who have received payment, and those who have not. Anxieties surrounding decreasing property prices because of wind farm development can also cause additional conflict.

INFLUENCE OF RENEWABLES ON ENERGY PRICES

A downward trend in electricity prices has been observed across Australia due to record levels of renewable energy. The Australian Energy Market Commission (AEMC) initially reported in 2020 that NSW households can expect reduced energy bills from 2020 to 2023 (AEMC, 2021). As of Q1 2023, the wholesale electricity price averaged $83/MWh, "down more than a 10th from the December quarter and two-thirds lower than the record average $264/MWh in the June quarter [of 2022]".

The fall in electricity prices is a result of lower wholesale electricity costs and lower environmental costs, which are two of the three key drivers of NSW consumers' energy bills (AEMC, 2021). The significant increase in renewable energy generation through rooftop solar, large-scale solar and wind farms across the country is said to be the main driver in reducing the wholesale electricity and environmental costs, as the energy market becomes less reliant on other energy sources, such as gas and coal and therefore less affected by their market price fluctuations. However, on July 1, 2023 the Australian Energy Regulator (AER) increased the "default market offer" by around 20% which in turn resulted in a 20 -23% retail price increase. This is largely because of inflation, including an increase in cost of building electricity transmission and distribution systems. Research by the Australian Academy of Technological Sciences & Engineering (ATSE) has stated that the transition to renewable energy is key to delivering more reliable and competitively priced energy in the future (ATSE, 2022).

The share of renewable energy in Australia's energy mix has grown by more than 30% in the last decade. In NSW, small and large-scale solar energy generation have doubled from 2015 to 2017 and more renewable energy projects are in the state's project pipeline. The expansion of renewable energy and its influence in electricity prices continue to benefit many Australian households and businesses, corroborating the call for the decarbonisation of the energy sector.

SOCIO-ECONOMIC DISPARITY

The Socio-Economic Indexes for Areas (SEIFA) provides a measure of the relative socio-economic advantage and disadvantage of geographical areas using ABS Census data. Relative socio-economic advantage and disadvantage, as defined by ABS, refers to "people's access to material and social resources, and their ability to participate in society". SEIFA uses socio-economic indicators such as but not limited to income, education, employment, occupation, and housing variables. In the context, the SEIFA provides an indication of the collective socio-economic characteristics of the communities in the study area and can highlight potential vulnerable communities that may be disproportionately affected by the Project. Based on 2021 Census data, Figure 6-74 shows the mapping of SEIFA percentiles on a statistical area level for the social locality and surrounds. A lower percentile (i.e., red and orange tiles on the map) represents a more disadvantaged area.

As demonstrated in Figure 6-74, the region surrounding the Project Site is extremely diverse in terms of socio-economic status, with areas of extreme advantage bordering areas of extreme disadvantage. This may have implications on the ability of community members to have their voices heard and opinions considered in the consultation process. Noting the relative disadvantage of the immediate surrounds of the Project Site, it may be more difficult for highly affected residents to participate in engagement activities, or have the resources needed to provide feedback (e.g., access to internet, mobile phone, etc.).

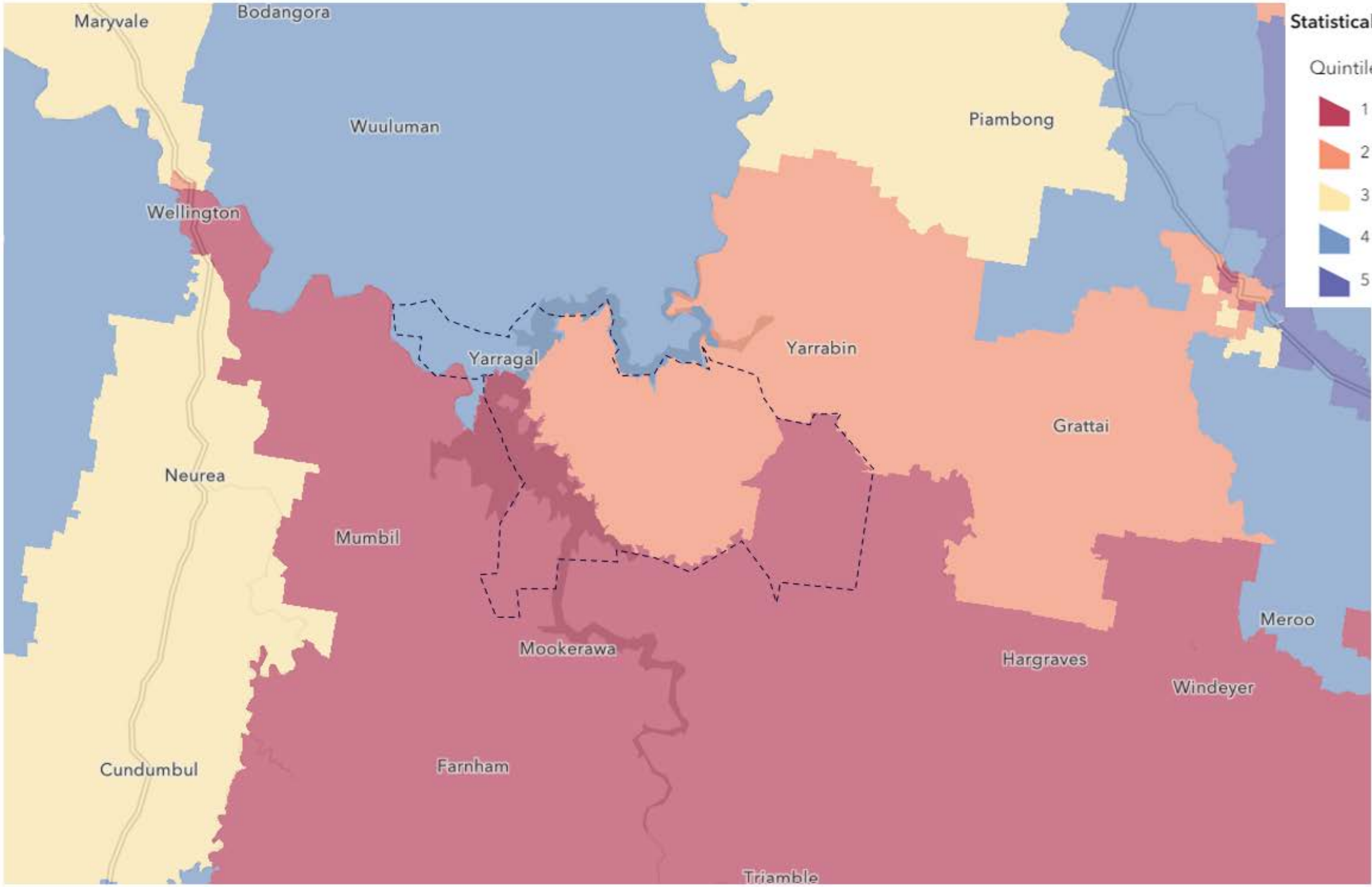


Figure 6-74: SEIFA scores surrounding the Project Site (dashed line) (Ethos Urban, 2023a)

6.13.1.5. Local Social Infrastructure

Due to the considerable size of the Project Site and the regional character of its environment, it is necessary to understand its potential impact on critical infrastructure. Categories of infrastructure that have been identified as influential to the health and wellbeing of residents in regional communities are as follows:

- Supermarkets, general stores, petrol stations (i.e., daily living needs)
- Transport hubs
- Community facilities
- Healthcare
- Education facilities
- Places of worship

These have been mapped at a distance approximate to a 30–35-minute drive from the Project Site boundary (Figure 6-75). Figure 6-76 and Figure 6-77 show the available social infrastructure in the two closet major towns to the Project, being Mudgee and Wellington.

The nearest cluster of infrastructure is located approximately 35 minutes from the north-western border if of the Project Site, in the suburb of Wellington. Wellington is a small regional centre within the Dubbo LGA which contains several healthcare facilities, including a hospital, supermarkets, schools, a TAFE, and places of worship. The township is also connected by rail to the Main Western line which runs from Sydney Central to Bourke. It is likely that many residents living to the west of the Project Site currently access critical infrastructure and services within Wellington to support their daily lives.

The suburb of Mudgee is located approximately 1 hour from the north-eastern border of the Project Site and contains a similar range of infrastructure types. The township is connected by rail to the Gwabegar railway line (non-operational since 2004). It is likely that many residents living to the east of the Project Site currently access critical infrastructure and services within Mudgee to support their daily lives.

While there are some isolated infrastructures (community facilities, schools, and supermarkets) scattered within a 35 minute distance in other directions, these are limited and sparsely distributed. It is likely that residents are required to travel to larger regional centres, such as Mudgee or Wellington, to obtain essential supplies and services.

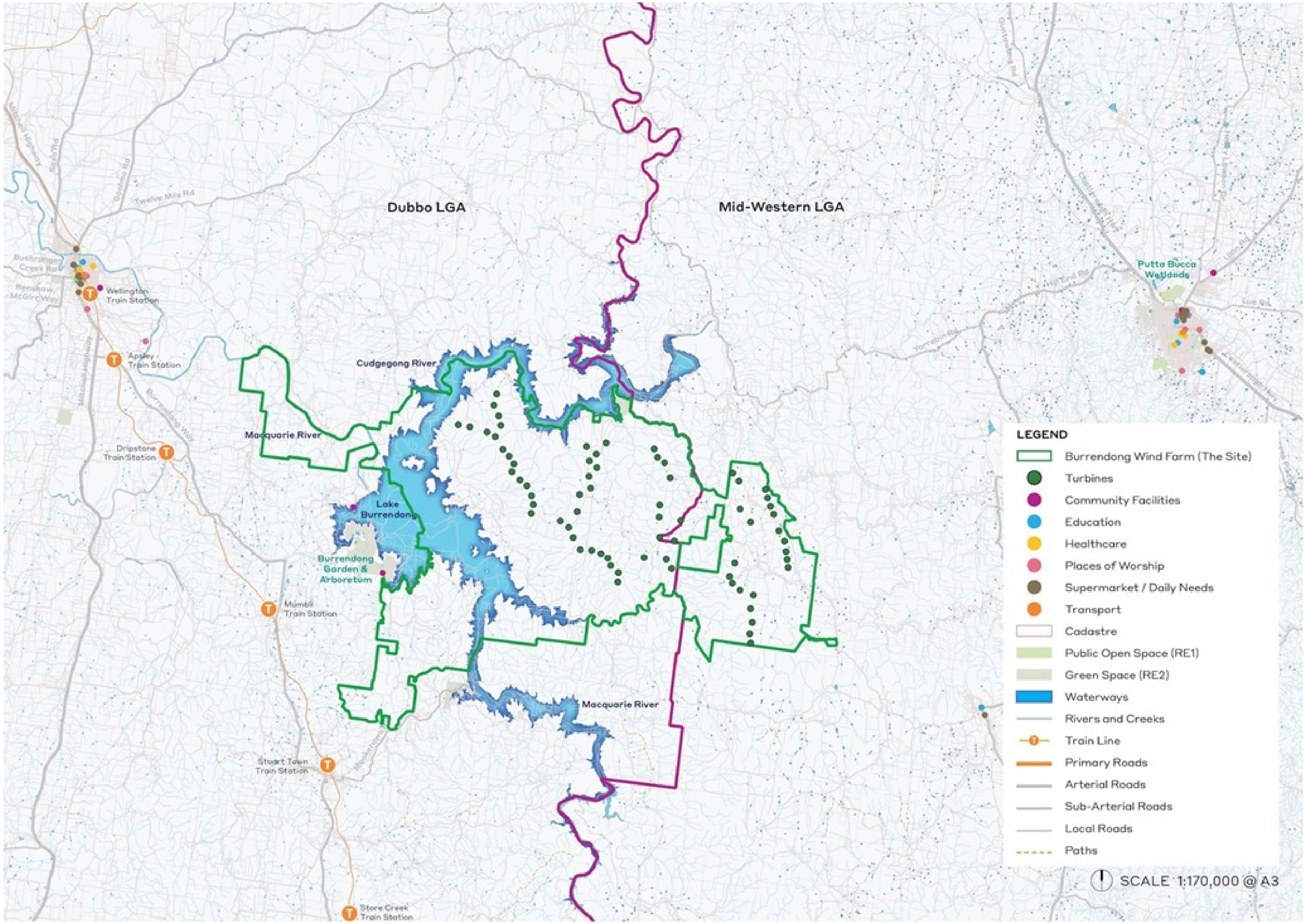


Figure 6-75: Project Site and surrounding social infrastructure (Ethos Urban, 2023a)

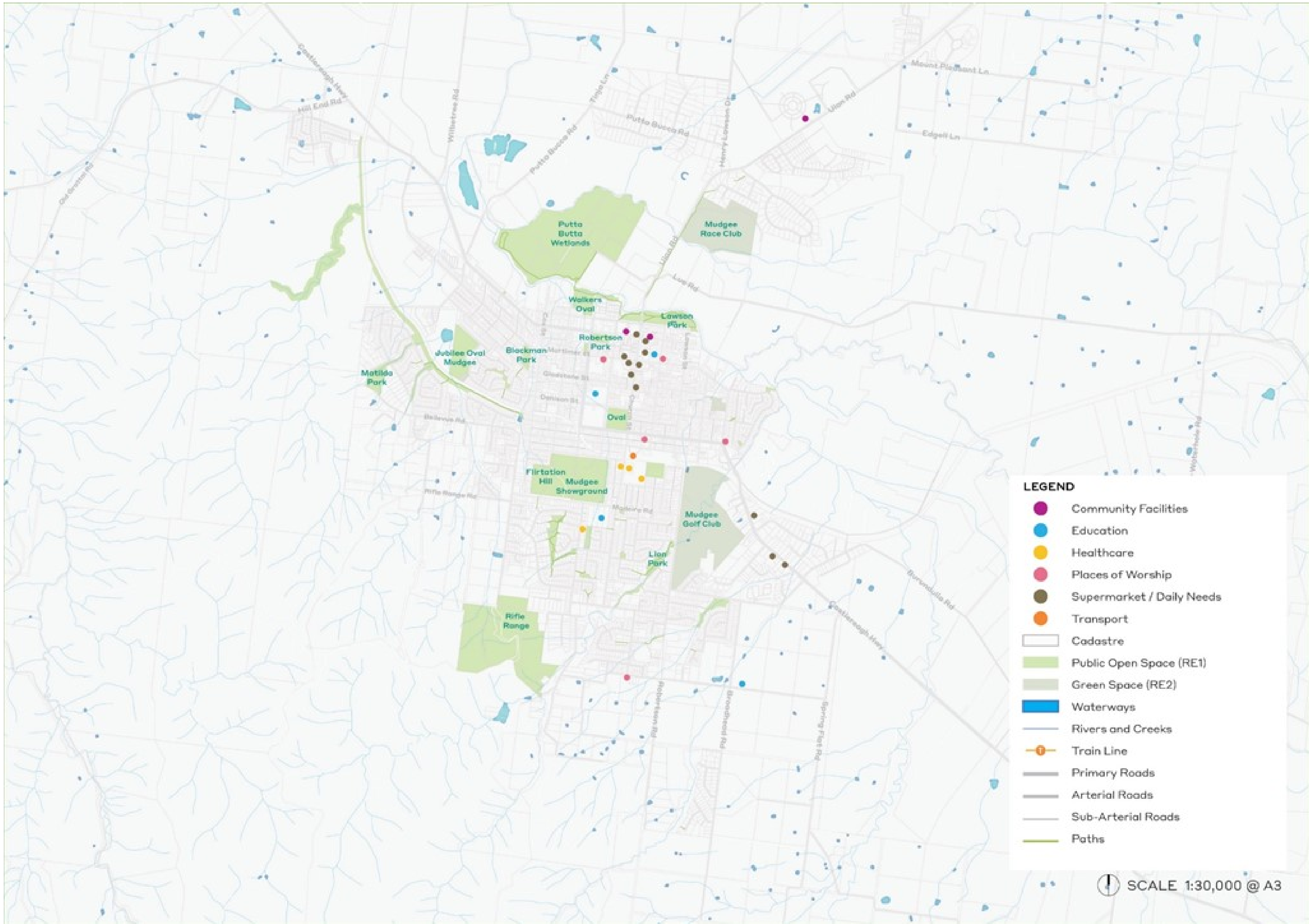


Figure 6-76: Social Infrastructure in Mudgee (Ethos Urban, 2023a)

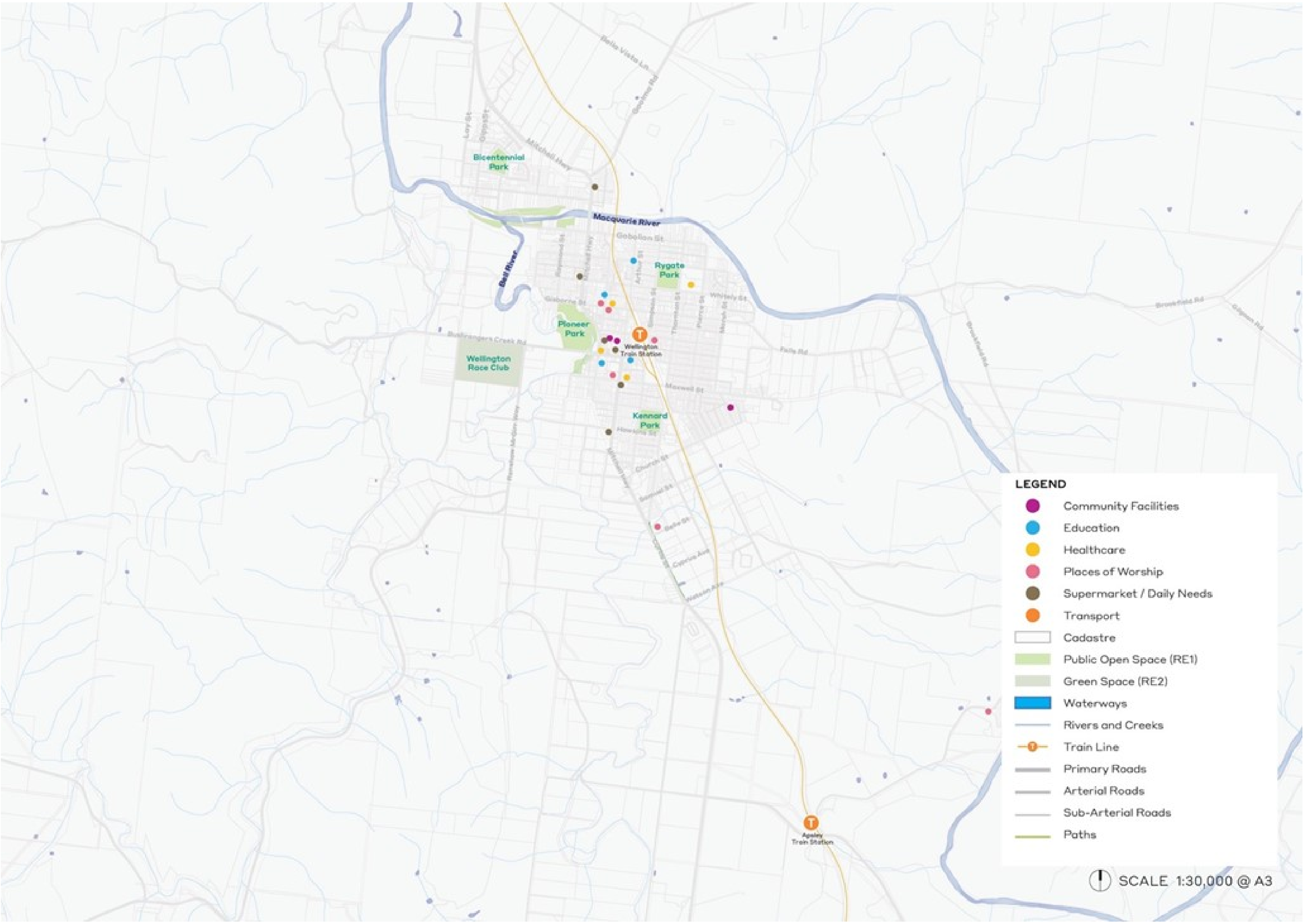


Figure 6-77: Social Infrastructure in Wellington (Ethos Urban, 2023a)

6.13.2. Potential Impacts

The following key social impacts were identified at the scoping stage, and have been considered as part of the SIA:

- Development Phase
  - Threat or expectation of change to way of life
  - Impacts to wellbeing, such as fear, anger, anxiety
  - Social conflict, rivalry, and feelings of envy, which disrupt the community cohesion
  - Impacts to sense of being able to influence decision-making for the community
- Construction Phase
  - Decreased accessibility due to changed local roads
  - Nosie, distribution from construction activities
  - Changes to the size and composition of the community
  - Impacts to housing demand from construction workforce
  - Increased employment opportunities
  - Increased patronage for local businesses
  - Cumulative impacts to residents and businesses of the REZ.
- Operational Phase
  - Impacts to amenity and visual environment
  - Cumulative impacts to residents of the REZ

Table 6-110 sets out the assessment of material social impacts arising from the Project and impact ratings following mitigation. Measures to enhance social benefits and mitigate potentially negative impacts, across a suite of factors are also provided. The assessment is framed around social impacts and identifies the key stakeholder groups who are likely to experience social impacts and benefits of the Project differently. These groups will also experience potential cumulative impacts as residents of the REZ differently, which has been addressed in the assessment.

Table 6-110: Social Impacts to three key stakeholder groups (Ethos Urban, 2023a)

Social Impact	Social Factors	Duration and Extent	Area of Impact	Impacted Stakeholder Groups	Impact Rating	Mitigation Approach and Project Refinements	Residual Impact after Mitigation
Impacted visual amenity and decreased enjoyment of surroundings due to changes visual character of the area. This may lead to loss of and changed connection to place.	Surroundings Way of life	Operation phase (Ongoing)	PSL (8km) and SSL	• Parttime residents • Fulltime residents • Local business and tourist services *Residents in north-east of PSL subject to cumulative impacts from the Uungula Wind Farm*	Almost certain Major – **Very High (negative)**	• Implement landscape and visual mitigation measures and recommendations outlined in Table 6-10. • Ensure WTG siting minimises visual impact. • Consult and discuss mitigations with the two non-participating residences within 3,350 m of WTGs. • Work with residents in the PSL to ensure ideal siting of WTGs.	Visual impacts can be mitigated to a small degree. However, the project will still be highly visually prominent, and this will not change. The residual impact related to visual amenity changes remains high. For some residents, the perception of the impact may decrease over time due to habituation. While for others, the high impact will remain.
Overshadowing and shadow flickering, leading to changed experience of surroundings, and possibility for annoyance. The LVIA identified that shadow flickering will likely impact two dwellings for a total of 30 hours a year (MLA, 2023; Appendix F).	Surroundings Way of life Health and wellbeing	Operation phase (Ongoing)	PSL – particularly those within the 5 km buffer	• Residents occupying the two affected dwellings identified in the LVIA (MLA, 2023; Appendix F).	Likely minor – **Medium (negative)**	• Implement landscape and visual mitigation measures and recommendations outlined in Table 6-10. • Reconsider WTG placement to eliminate showing flickering on impacted residences.	Given the low severity of shadow flickering impacts identified by the LVIA, the reconfiguration of wind WTG placement may eliminate flickering impacts. If elimination is not possible, it is noted that the impacted residences will likely be participating landholders.
WTGs may generate some noise that may cause annoyance for a small portion of residents in the PSL.	Health and wellbeing Way of life	Operation phase (Ongoing)	PSL	• Fulltime residents who are participating landholders or close to the PSL • Parttime residents who are participating or live close to WTGs.	Possible Moderate – **Medium (negative)**	• Implement landscape and visual mitigation measures and recommendations outlined in Table 6-26.	Potential noise impacts may affect fulltime and parttime residents near WTGs. This can be reduced by adhering to recommended mitigation measures. However, residents who are most likely to be impacted by noise will be participating landholders.
Threat or expectation to change of way of life, or fear and anxiety about the development. Anxiety towards wind farm development may impact residents and is largely dependent on personal sense of connection to place, degree of support for the Project and level of concern around impacts. There may be fear about how the Project will impact the desirability of the area as a visitor or tourist destination, or an impact on farming practices.	Way of life Decision-making systems Community Livelihoods Health and wellbeing	Development, Construction Phases (Temporary – 2 years)	PSL	• Fulltime residents • Parttime residents • Local business and tourist services.	Possible Moderate – **Medium (negative)**	• Continuation of community engagement and communications for life of Project. • Develop a community benefit sharing program, to be co-designed with residents of the PSL. • Ensure implementation of landscape and visual, noise and vibration and land use conflict mitigation measures and recommendations outlined in Table 6-10, Table 6-26 and Table 6-89, respectively.	For some residents who oppose the Project, the impacts may remain irrespective of engagement that has been conducted during the Project development phase. For residents who are neutral or support the Project, impact over time will lessen.
Perception that there will be decreasing property values because of proximity to WTGs and changed character of the area. Research referenced in the SIA notes that this is not supported by evidence.	Livelihoods	Construction and operation phase (Ongoing)	PSL and SSL	• Fulltime residents • Parttime residents	Unlikely Minor **– Low (negative)**	• Consistent, ongoing communications on project details, impacts and benefits.	Landholders opposed to wind farms may remain concerned over property value decline, however this fear may lessen over time.
Social conflict over differing degrees of support for the project, undermining community cohesion and resilience. Potential alteration of community social structure, impacting community cohesions and reputation of local institutions.	Community Way of Life	Development, construction, possibility to continue into operation phase (Ongoing)	PSL and SSL	• Fulltime residents • Parttime residents • Workers in the PSL • All stakeholder groups	Possible Moderate – **Medium (negative)**	• Commencement of community benefit sharing program development, developed through extensive engagement with impacted locals.	Severity of disrupting relationships may be reduced by distributing benefits through a community benefits program, supported by strong engagement and communication. For disrupted community networks and relationships, they may be re-built over time.

Social Impact	Social Factors	Duration and Extent	Area of Impact	Impacted Stakeholder Groups	Impact Rating	Mitigation Approach and Project Refinements	Residual Impact after Mitigation
Changes to the composition of the community, with temporary construction workers moving into the area, changing the sense of community. 250 FTE workers are expecting over a 2-year construction period – reaching 375 workers at the peak of construction. This forms part of larger cumulative impacts resulting from renewable energy development in the REZ.	Community	Construction Phase (Temporary, 2 years for the Project) (Medium term for REZ)	PSL and SSL	• Fulltime residents • Parttime residents	Possible Minor – **Moderate (negative)**	• Develop a construction Workforce Housing and Accommodation Strategy • Develop a Workforce Management Plan	This will impact communities in the PSL and SSL, and across the REZ for the duration of construction and operational activities. Forms part of larger cumulative impacts from renewable energy development in the REZ. However, SSL and REZ residents may become accustomed to the construction workers and changed local area. For others the impact will be ongoing.
Community pride, generated through landholders hosting a renewable energy project together with a developer, feeling a sense of ownership of their local area and pride at being able to support the green energy transition and addressing climate change in some small way.	Community Surroundings	Operation phase (Ongoing)	PSL	• Fulltime residents	Possible Minor – **Moderate (Positive)**	• Continuing engagement and project development together with participating landholders	Potential for increased community pride due to clean energy production. This will impact communities in the primary and secondary social locality for the duration of operational activities, and over the continuing growth of the REZ.
Diminished ability to connect to Country, due to changed landscapes. The ACHA outlines cultural heritage sites located across the Project's site footprint, highlighting the potential for negative impacts for land clearance associated with WTG access trails.	Culture	Construction and operation phase (Ongoing)	PSL and SSL	• First Nations groups	Unlikely Major – **Medium (negative)**	• Implementation of Aboriginal heritage mitigation measures and recommendations outlined in Table 6-67 and Table 6-68. • Implementation of a CHMP developed in consultation with local registered Aboriginal parties. • Ongoing engagement with local First Nations stakeholders throughout construction phase.	Potential impacts to culture associated with disrupted access to Aboriginal sites of significance. This will impact communities in the PSL and SSL for the duration of the Project. Once a CHMP is implemented, the risk of disturbing cultural heritage site will be significantly reduced.
Construction related noise, dust, vibration, traffic, and disruption, causing irritation, annoyance, or disruption to way of life for people living in accessing the PSL.	Way of life	Construction Phase (Temporary, 2 years)	PSL	• All stakeholder groups, but especially those within 5 km PSL	Likely Moderate – **High (negative)**	• Implementation of a construction management plan according to advice provided within technical reports.	Daily routines may be impacted despite the implementation of mitigation measures. It is noted that landholders who will likely experience these impacts most severely are likely to be participating landholders.
Strain on regional infrastructure, services, and housing, with 250 FTE workers coming into the area (375 FTE at construction peak).	Way of life Accessibility	Construction Phase – (Temporary, 2 years) Ongoing (development in the REZ, 10+ years)	PSL, SSL and the REZ	• Fulltime residents in the PSL • Workers in the PSL • Parttime residents of the PSL.	Likely Moderate – **High (negative)**	• Prepare a construction workforce housing and accommodation strategy, conjunction with stakeholders (including both councils) • Develop and implement and Workforce Management Plan, to define standards of behaviour for workers and how worker needs (such as healthcare) will be supported with minimal impact to locals' ability to access services.	Potential to impact the daily life of residents and workers in the PSL may still occur, even with appropriate management approaches by the proponent. The scale of the impact can be decreased through appropriate management. As part of broader change in the REZ, however, this impact is likely to still be felt by REZ residents and businesses even with mitigation.
Impacts to accessibility due to increased travel times during construction, and potential for risk to other road users (drivers, cars, cyclists, pedestrians). The TTIA identified an expected increase in traffic over the life cycle of the Project, particularly in the construction phase, also noting the cumulative traffic impacts caused by renewable energy development across the REZ (Stantec 2023).	Accessibility	Construction Phase (Temporary, 2 years)	PSL	• Fulltime residents and workers in the PSL • Parttime residents • Local business and tourist services	Possible Moderate – **Medium (negative)**	• Implementation of traffic and transport mitigation measures and recommendations outlined in Table 6-53. • Implementation of a Construction Traffic Management Plan. • Implementation of an Engagement and Communications Plan to communicate with affected stakeholders and residents throughout the construction phases.	This will impact landholders in the PSL for the duration of construction activities. Appropriate traffic management techniques will reduce much of the impact. Road safety will remain a risk thought the construction phase; however, this risk can be significantly reduced though management and planning, specifically around seasonal peaks in tourist activity and strong community communications.

Social Impact	Social Factors	Duration and Extent	Area of Impact	Impacted Stakeholder Groups	Impact Rating	Mitigation Approach and Project Refinements	Residual Impact after Mitigation
Fear of damage to local biodiversity and ecosystem, impacting on people's connection to the local environment. The local environment has significant conservation areas and areas for enjoyment of nature, which are likely to be highly valued by locals.	Surroundings Health and wellbeing	Development and Construction Phase (Temporary, 3 years)	PSL	• Fulltime residents • Parttime residents • Local business and tourist services.	Unlikely Minor – Low (negative)	• Implementation of biodiversity and agriculture mitigation measures and recommendations outlined in Table 6-44 and Table 6-89, respectively. • Implement Engagement and Communications Plan to communicate with affected stakeholders and residents throughout the construction and operational phases, and explain how environmental impacts will be managed and risks mitigated	However, ecological damage can be minimised due to project layout and strict adherence to protection protocols. With all required mitigation and management, the risk for damage is low. However, for some residents, fear of damage may remain. Overtime, the fear may decrease.
Perception or fear of decreasing farmland supply, leading to fears that traditional practices in the area may not be supported. Wider change in the REZ may contribute to these fears, as farmers see the area changing.	Surroundings	Operation phase (Ongoing)	PSL, SSL and the REZ	• Fulltime residents • Parttime residents • Workers in the PSL engaged in farming	Unlikely Minor – Low (negative or positive, depending on financial benefit and support for renewable energy development)	• Implementation of agriculture mitigation measures and recommendations outlined in Table 6-89. • Engage with affected stakeholders and residents throughout the construction and operational phases, with focus on communicating how the project will manage and minimise impacts on farmers.	Fears associated with farmland availability may remain across the PSL and SSL. Overtime perceived fears may decrease due to messaging through the lived experience wherein stakeholders' fears do not materialise.
Increased employment opportunities and flow on affects to local businesses, via direct employment in the construction or uplift in spending in local businesses. The project will contribute 25- FTE jobs over 2 years, peaking at 375 FTE during the project.	Livelihoods	Construction Phase (Temporary)	PSL and SSL	• Workers in the PSL and SSL	Likely Major – High (positive)	• Implementation of social procurement strategy to ensure local community and disadvantaged groups can benefit from the employment and business opportunities associated with construction.	Potential benefits to livelihoods across the SSL associated with the availability of local employment will endure throughout the construction period and can be amplified in impact by a social and sustainable procurement policy to maximise benefits to local workers and businesses. The capacity of local firms will likely benefit in the long term (5-10 years) from ongoing renewable energy development across the region.
Financial benefits to participating and host landholders, and community benefits via a Community Benefit Sharing program.	Livelihoods	Operation phase (Ongoing)	PSL	• Fulltime residents and parttime residents, either those hosting WTGs or eligible for payment due to proximity to WTGs.	Almost certain Transformational – Very High (positive)	• Implementation of community benefit program developed through co-design with residents in the PSL.	Benefits will endure for the operating period of the Project.

6.13.3. Mitigation Measures

Table 6-111 outlines the proposed measures to mitigate potential social impacts.

Table 6-111: Mitigation Measures for Social Impacts

Social Impact	Mitigation Measure	Reference Code
All Social Impacts	Implement Social Impact Monitoring Plan (SIMP) per Section 8 of the SIA (Ethos Urban, 2023a; Appendix S).	SI001
	Develop and implement an engagement and communications strategy to guide how engagement and communication with affected and interested stakeholders and residents throughout the construction and operational phases. The strategy should seek to: • Ensure all interested or affected parties are identified and lay out how these people will be engaged with in an ongoing manner over the coming years. • Place key project stakeholder relations team members in the local area, so community members have a consistent point of contact with someone locally located. • Establish trust and dialogue with the community to understand community concerns, provide key information, and develop strong understanding of wind energy. • Ensure timely, useful, and relevant information is provided to all parties. • Work collaboratively with impacted groups to minimise negative impacts of the project.	SI002
Positive Impacts through Community Benefit Sharing	• Commencement of community benefit program, developed through extensive engagement program based on the principles of co-design. • Community should play a large role in shaping the focus of the program to align with local needs. • Distribute the financial benefits of the wind farm across the winder affected community, beyond only participating landholders. This works towards improving community cohesion by building consensus around tangible benefits delivered to the wider community in a targeted manor based on engagement and consultation outcomes. • The program should also be administered in a way that community feel they have ongoing ownership of the program, such as guided by the Community Reference Group (CRG) set up for this purpose.	SI003
Strain on Local Workforce, Infrastructure, Services, and Accessibility	Prior to commencing construction, prepare a Construction Workforce Housing and Accommodation Strategy for the Project in consultation with the two Councils, to include: • Measures to ensure there is sufficient accommodation provided for the workforce associated with the development and ensures that the proponent does not rely on tourist accommodation nor the local rental market. • Consider the cumulative impacts associated with other State significant development projects in the area and how accommodation will be managed to make a positive contribution to the REZ. • Propose a clear method for transporting workers to and from site and accommodation that minimises any impact of residents.	SI004

Social Impact	Mitigation Measure	Reference Code
	• Include a program to monitor and review the effectiveness of the strategy over the life of the development, including regular monitoring and review during construction.	
	Develop a Workforce Management Plan, that works to minimise impacts on community, through consideration of: • Standards of behaviour for workers. • How worker needs will be met without impacts local essential services and infrastructure, such as health needs.	SI005
	Develop and implement Social Procurement Strategy to ensure local and disadvantaged groups and workers can benefit from the employment and business opportunities associated with construction.	SI006
Social Impacts Relating to other Impacts	Implement the recommendations of technical assessments and management plans (e.g., noise, traffic, cultural heritage).	SI007

6.14

Economic

An Economic Impact Assessment has been prepared by Ethos Urban (2023b, Appendix T). The EIA has been undertaken in accordance with the requirements of the SEARs, which include:

- *Assessing any benefits of the economic impacts or benefits of the Project for the region and the State as a whole, including consideration of any increase in demand for community infrastructure services, and details of how the construction workforce will be managed to minimise local impacts, including a consideration of the construction workforce accommodation.*

Assessment Overview

The Project will inject millions of dollars through direct employment, local investment, and wage stimulus into the local economies within the LGAs of Dubbo and Mid-Western, representing 81,710 people in June 2022. The regional labour market is tight, highlighted with the Study Area's existing low unemployment rate of 3%. As part of the Proponent's commitment to positively contributing to local and regional communities and economies, they have indicated that approximately 25% of the Projects workforce will be sourced from the local region. This will provide several new short-term employment opportunities (250 FTE construction jobs) as well as a small amount of ongoing employment opportunities (12 FTE direct jobs).

The Project has an approximate investment value of $800 million during the construction phase, with $120 million anticipated to be retained within the Study Area.

External Project labour requirements are expected to generate an accommodation need for approximately 280 FTE workers at the peak of construction. The influx of workers during the construction phase is expected to inject approximately $21.4 million in new spending into local economies (approximately 24-30 months), supporting approximately 53 FTE jobs in the Study Area's service sector. Ongoing economic stimulus associated with the operation of the Project is estimated at approximately $190 million over 30 years of operation (adjusted for CPI). This stimulus includes operational wages, host and neighbouring landholder payments and payments to the community.

Mitigation measures have been provided in Section 6.14.3.

6.14.1. Existing Environment

6.14.1.1. Study Area

The regional centres and townships, to differing extents, are likely to play important roles in supporting the requirements of the Project. Therefore, for the purposes of the Economic Impact Assessment (Ethos Urban, 2023b), the following definitions have been used:

- **The Project Site:** Comprised of 17 private landowners (containing 147 freehold lots) and 58 lots owned by the State of NSW and currently used for farming purposes (cattle and sheep grazing)
- **The Study Area:** Comprised of both the Dubbo Regional Council and the Mid-Western Regional Council

The main regional cities/townships/settlements in the Study Area are all located within a 2 hour drive from the Project Site as shown in Table 6-112.

Table 6-112: Population and approximate travel time from the Project Site to regional cities and townships (Ethos Urban, 2023b)

City or Township	LGA	Population	Travel Time (drive)
Dubbo	Dubbo	41,000	120 minutes
Wellington	Dubbo	4,700	85 minutes
Mudgee	Mid-Western	11,700	35 minutes
Gulgong	Mid-Western	2,000	45 minutes
Rylstone	Mid-Western	660	70 minutes

6.14.1.2. Population

Projections of populations within the Study Area have been prepared with reference to the NSW DPE Population Projections (2022) and rebased against the latest ABS Estimated Resident Population (ABS, 2023a; ABS, 2023b) figures for the respective cities or townships. The key findings of the EIA found:

- In 2022, the Study Area is estimated to have supported a total population of 81,710 persons. A high proportion of this population is located within Dubbo Regional LGA, with 55,840 residents.
- Over the projected period from 2022-2036, the total population of the Study Area is forecast to increase by +9,700 residents. This reflects an average annual increase in the resident population of around 690 persons, at a rate of +0.8% per annum.
- The above forecast growth rate for the Study Area is below the forecast rate for New South Wales (NSW) of +1.0% per annum over the same period.
- Population growth within the Study Area is estimated to be largely concentrated within Dubbo Regional LGA.

The construction and operational phases of the Project will provide an economic stimulus (inc. additional jobs, Project contracts, new spending, etc.) to the local economy, as well as support the emergence of the region's renewable energy sector. A summary of population projections within the Study Area are shown in Table 6-113.

Table 6-113: Population projections for the study area, 2016 - 2036 (ABS, Dept. of Environment and Planning)

LGA/Area	2016	2022	2026	2031	2036	2022 - 2036
			Population (no.)			
Dubbo Regional Council	51,400	55,840	57,760	60,160	62,510	+6,670
Mid-Western Regional Council	24,550	25,870	26,750	27,850	28,900	+3,030
Study Area	**75,950**	**81,710**	**84,510**	**88,010**	**91,410**	**+9,700**
			Average Annual Growth (no.)			
Dubbo Regional Council	-	+740	+480	+480	+470	+480
Mid-Western Regional Council	-	+220	+220	+220	+210	+220
Study Area	**-**	**+960**	**+700**	**+700**	**+680**	**+690**
			Average Annual Growth (%)			
Dubbo Regional Council	-	+1.4%	+0.8%	+0.8%	+0.8%	+0.8%
Mid-Western Regional Council	-	+0.9%	+0.8%	+0.8%	+0.7%	+0.8%
Study Area	**-**	**+1.2%**	**+0.8%**	**+0.8%**	**+0.8%**	**+0.8%**
New South Wales	-	+0.9%	+0.9%	+1.1%	+1.0%	+1.0%

Note: figures have been rounded

6.14.1.3. Labour Force

As of March 2023 (latest available), the Study Area had a labour force of 44,480 persons and an unemployment rate of 3.0% (DESE). This is lower than the unemployment rate for NSW (3.3%). The Study Area currently has approximately 1,330 persons who are unemployed.

The Project is likely to require approximately 375 workers during the peak of construction. It is anticipated that approximately 25% of these workers will be sourced from within the Study Area (or 280 workers), providing new opportunities for unemployed job seekers (subject to appropriate skills match) or 'back filling' employment opportunities associated with jobs vacated by workers taking up project employment.

The Project also has potential to provide new opportunities for workers who are beginning or seeking to transition from the mining sector to the renewable energy sector. This transition is predominately driven by Global, Federal, and State reduced emissions targets associated with electricity generation. At the time of the 2021 Census, approximately 6.2% of the Study Area's resident labour force (2,200 workers) were employed in the mining sector.

Table 6-114: Resident Labour Force Statistics - Study Area, March 2023 (DESE, 2023)

LGA/Area	Labour Force	Unemployed	Unemployment Rate
Dubbo	31,190	1,100	3.5%
Mid-Western	13,290	230	1.7%
Study Area	**44,480**	**1,330**	**3.0%**
New South Wales	4,423,000	147,500	3.3%

6.14.1.4. Occupational Structure

The skills base of the Study Area is reflected in its occupational structure. ABS Census data for 2021 highlights that approximately 34.9% of employed residents in the Study Area occupied in construction-related activities as highlighted in yellow in Table 6-112 (e.g., technicians and trades workers, machinery operators and drivers, and labourers).

The representation of these occupations in the Study Area is significantly above the State average (26.5%), indicating a generally suitable occupational base for the Project in the region. In total numbers, 12,600 workers in the Study Area are occupied in construction-related activities, highlighting the strong worker base available to support larger infrastructure projects.

Table 6-115: Study Area workers - Occupational Structure (ABS, 2021b)

Occupation	Study Area	New South Wales
Managers	13.1%	14.8%
Professionals	17.3%	26.4%
Technicians and trades workers*	15.4%	12.1%
Community and personal service workers	14.1%	10.8%
Clerical and administrative workers	11.8%	13.3%
Sales workers	8.9%	8.2%
Machinery operators and drivers*	8.4%	6.1%
Labourers*	11.0%	8.3%

Note: Figures have been rounded

*** Occupations mostly likely to be involved in the construction of the Project**

6.14.1.5. Business Structure

A tangible benefit of a major investment project is the extent to which local businesses can participate through project contracts and other service provision.

ABS Business Count data for June 2022 (latest available) shows the Study Area includes some 1,480 construction businesses (rounded), representing 17.7% of all businesses located in the Study Area (Table 6-116). This data indicates a reasonable presence in the Study Area of the types of firms that have potential to service aspects of the Project. Although construction-related businesses will likely be the main beneficiaries of the Project, businesses in other sectors supporting the Project (directly and indirectly) are also likely to benefit, including:

- Retail trade
- Accommodation and food services
- Rental, hiring and real estate services
- Health care and social assistance

These sectors make up approximately 25.7% of all businesses located in the Study Area and their services will likely play a role in supporting the needs of project workers, especially those relocating to the Study Area to work on the construction phase of the Project.

Table 6-116: Business Structure - Study Area, 2022 (ABS, 2022)

Industry	Non employing	1-19 Employees	20-199 Employees	200+ Employees	Total
Agriculture, Forestry and Fishing	1,642	515	15	0	**2,172**
Mining	24	21	0	0	**45**
Manufacturing*	126	141	19	0	**286**
Electricity, Gas, Water and Waste Services	18	4	0	0	**22**
Construction*	829	635	18	0	**1,482**
Wholesale Trade	95	84	15	0	**194**
Retail Trade*	166	240	17	3	**426**
Accommodation and Food Services*	117	275	32	0	**424**
Transport, Postal and Warehousing	299	151	12	0	**462**
Information Media and Telecommunications	20	10	0	0	**30**
Financial and Insurance Services*	112	71	3	0	**186**
Rental, Hiring and Real Estate Services*	610	90	0	0	**700**
Professional, Scientific and Technical Services	243	272	8	0	**523**
Administrative and Support Services	154	132	7	0	**293**
Public Administration and Safety	8	7	4	0	**19**
Education and Training	42	44	4	0	**90**
Health Care and Social Assistance*	231	162	18	3	**414**
Arts and Recreation Services	37	38	0	0	**75**
Other Services	226	266	7	3	**502**
Currently Unknown	7	0	0	0	**7**
TOTAL	**5,006**	**3,161**	**178**	**6**	**8,351**

***** Businesses expected to be the biggest beneficiaries of the Project

6.14.1.6. Township Services Capacity

Based on discussions with the Proponent, approximately 75% of the construction workforce are likely to be non-local (i.e., sourced from beyond the Study Area). This means that on average, around 75 workers would require accommodation per month across the 24-month construction phase, with this figure increasing to approximately 130 persons at peak construction.

COMMERCIAL ACCOMMODATION

Ethos Urban undertook an audit of the commercial and private accommodation options located within the Study Area's major townships. These townships generally represent a maximum drivetime of 60-minutes to the Project Site. The Study Area's commercial accommodation capacity is currently approximately 830 rooms/cabins, as shown in Table 6-117.

Most accommodation options in the Study Area are located at Mudgee, reflecting the town's role as a regional service centre. A more limited provision of visitor accommodation is in the smaller towns of Gulgong, Wellington and Rylstone. Existing accommodation in Gulgong and Wellington plays a key role in supporting the tourist role of both townships. Tourism visitation to Gulgong is associated with its idyllic main street and historic role as the childhood home of Henry Lawson, while Lake Burrendong and Wellington Caves draw visitors to Wellington.

The range of short-term commercial accommodation options available in the Study Area is reasonably diverse and includes motels, hotels, guest houses, caravan/holiday parks. However, the depth of supply may not be sufficient to service accommodation demands associated with multiple concurrent infrastructure projects in the Study Area as well as existing markets. The cumulative impact assessment at Section 4.3 of the EIA report highlights the construction phase of eight renewable energy projects located in the Central West and Orana REZ will likely overlap with the Project.

From an economic perspective, the key concern is that the commercial accommodation demands of the project in addition to other large infrastructure projects in the Study Area results in a shortage of rooms for other sectors, including general business visitation and tourism visitation, resulting in negative impacts to these sectors.

While official room occupancy rates are unavailable at a local level, the NSW Government publish quarterly snapshot data sourced from the STR database (an official Australian Government database). The STR Tourist Accommodation Snapshot for December Quarter 2022 shows the Central NSW Region, in which the Study Area is located, averaged annual room occupancy rates of 66.3%, which is below the NSW occupancy rate of 72.7% for this period.

Table 6-117: Commercial accommodation within a 60-minute drive of the Project, April 2023 (Ethos Urban, 2023b)

Township	Establishments	Rooms	Cabins	Total
Mudgee	24	471	69	540
Gulgong	9	114	12	126
Wellington	11	108	29	137
Rylstone	2	27	0	27
TOTAL	**46**	**720**	**110**	**830**

PRIVATE ACCOMMODATION

Private accommodation is often used to support construction worker needs for major renewable energy projects. This could be through leasing of holiday homes and investment properties, either privately (including Airbnb), or through real estate agents.

The Study Area has a higher share of unoccupied dwellings (10.3%) when compared to the NSW average (9.4%) as shown in Table 6-118. The Mid-Western municipality has a significant share of unoccupied dwellings (15.0%). It is possible that some of these unoccupied dwelling (subject to tenant suitability) may enter the market to support the project and other major infrastructure projects in the region.

As with many large projects relying on local accommodation, local rental markets can reach full utilisation and at times require further supply be brought to the market during construction. Potential exists that the private accommodation demands of the multiple concurrent renewable energy project in the Study Area (including the Project) could result in a shortage of established (long-term) rental supply putting upward pressure prices and the potential for local renters to be priced out of the market.

The vacancy rate for long-term rental properties at Mudgee – the primary town that would service the needs of the project – was 4.7% in May 2023 (or approximately 90 properties). This indicates there is some capacity in Mudgee's rental market to potentially play a role in accommodating non-local workers in the Project's construction phase. Short-term accommodation provides another option for construction workers. Some 787 active short-term rentals are currently advertised in the Study Area (based on data sourced from www.airdna.co in June 2023). This represents an estimated 2,090 rooms, based on an average of 2.7 rooms per rental. However, it is likely that many of these rooms already play a role in servicing a range of visitor sectors including business travellers, tourists, seasonal agriculture workers and the visiting friends and family cohort.

Notwithstanding, the possibility exists that more short-term accommodation supply could enter the market in the Study Area to meet increased demand from the construction phases of renewable projects in the Central West and Orana REZ.

Table 6-118: Total occupied and unoccupied within the study area (Ethos Urban, 2023b)

LGA	Occupied Dwellings		Unoccupied Dwellings	
	Number	%	Number	%
Dubbo	19,280	92.2%	1,620	7.8%
Mid-Western	9,640	85.0%	1,700	15.0%
TOTAL (Study Area)	**28,920**	**89.7%**	**3,320**	**10.3%**
New South Wales	2,900,470	90.6%	299,520	9.4%

TOWNSHIP SERVICES

In addition to accommodation, workers locating temporarily to the Study Area will require a wide range of other convenience services, and the Project will also need to source trade, equipment hire, fuel, vehicle mechanical services, and other services from businesses located in the immediate region. Table 6-119 provides an overview of the services located within regional cities/townships in the Study Area that may service some needs of the Project.

Table 6-119: Overview of services provided within the Study Area (Ethos Urban)

Regional Centre of Township (by LGA)	Description of services

Dubbo	Dubbo, a 120-minute drive northwest of the Project Site, is the major regional centre for NSW's Central West region and has a population of approximately 41,000 persons (rounded) (source: ABS ERP for Dubbo Significant Urban Area). Dubbo supports a range of major civic, education, health and commercial services for an expansive rural area comprising a network of many smaller towns.
	Key services in Dubbo include:
	• Higher order retailing, including the following malls/shopping centres:
	  o Dubbo Square
	  o Orana Mall
	  o Riverdale Shopping Centre
	• Large range of professional/commercial services – solicitors, accounting, conveyancing, etc.
	• Major banks and financial institutions.
	• Entertainment – parks, hotels, clubs, sports and recreational activities.

<table>
<tr><th>Regional Centre of Township (by LGA)</th><th>Description of services</th></tr>
<tr><td></td><td>

Dubbo Airport – the main regional airport for the Central West region. It services daily flights to destinations including Sydney, Brisbane, Canberra, and Melbourne as well as regional centres. Four airlines operate from Dubbo Airport (Qantas Link, Rex Regional Express, Link Airways, and Airlink.
Dubbo Base Hospital – which operates as the major regional hospital with the emergency department for the Central West Region.
Dubbo Private Hospital – offers a comprehensive range of acute medical and surgical services and rehabilitation programs.
Education – Dubbo's network of educational institutions comprises four (4) tertiary institutions, three (3) private secondary schools and three (3) public secondary schools, and a range of primary and early education facilities.

Dubbo has an expanded range of service industry geared to civil construction works. Key businesses include:

NACAP (an engineering, procurement, and construction contractor, specialising in large infrastructure projects).
Mining Camps Australia (portable accommodation provider).
EMS Group (equipment and labour for mining and other infrastructure projects).
Cobra (plant and crane hire).
Wes Trac Cat (supplier of construction, mining, and agriculture equipment).
Ezyquip Hire (earthmoving equipment).
UGL Depot (associated with delivery of the Regional Rail Project).
Rod Pilon Transport.
Summit Cranes.

</td></tr>
<tr><td>Wellington</td><td>
Wellington, with a population of 4,700 persons (rounded) (ABS ERP 2022), is located approximately an 85-minute drive-time west of the Project Site. The township functions as a local service hub for surrounding agriculture areas and attracts visitors to the Wellington Caves Complex, Lake Burrendong State Park, and Mount Arthur Reserve. In addition, two prisons Wellington Correctional Centre and Macquarie Correctional Centre, and Wellington Solar Farm are situated to the north-east of the township off Gulgong Road.
Key services in Wellington include:

A range of commercial accommodation options.
Wellington District Hospital – a small regional hospital with an emergency department.
Two (2) full-line supermarkets (Coles & Woolworths).
Entertainment and dining – several hotels and a variety of cafes and restaurants.
A limited collection of commercial and financial services, including Commonwealth and NAB branches.
Fuel supplies – e.g., Ampol, BP, Metro Petroleum.
Postal Service.
Education – two (2) primary schools (Catholic and public), a secondary school (public) and a TAFE NSW Campus.
Train station – Wellington station is situated in the Central West line which has a daily service operating between Sydney and Dubbo.

</td></tr>
<tr><td>Mudgee</td><td>Mudgee, with a population of some 11,700 persons (rounded) (ABS ERP 2022), is the second largest town in the Study Area and is the regional service centre for the Cudgegong River Valley region and Mid-Western Regional Council. Mudgee is approximately 35-minutes (drive-time) south of the Project Site. While the Mudgee district is historically noted for gold mining, the township now operates as a regional services hub for local agriculture including viticulture, sheep, and cattle grazing, cropping etc, as well as mining (Ulan, Wilpinjong and Moolarben Coal Mines). The level of</td></tr>
</table>

Regional Centre of Township (by LGA)	Description of services
	services/facilities available in Mudgee is generally consistent with the township's regional service role, and includes: • A wide range of commercial accommodation options (hotels, motels, caravan parks, etc.). • Mechanic and trade supplies (including Bunnings). • Construction and transport services (incl. Coates Hire, Westrac CAT, Mid State Freight, Mudgee Cranes, West Crane Services). • Fuel supplies & automotive mechanics. • Supermarkets – full-line Coles & Woolworths, as well as ALDI. • Cafes, bakeries, restaurants and take-away. • Range of commercial and financial institutions – banks, solicitors, conveyancing, etc. • Entertainment (parks, hotels, clubs, sports, and recreational activities). • Education – including TAFE NSW, the Australian Rural Education Centre, five (5) primary schools, one (1) secondary school, two (2) combined schools & one (1) special needs school. • Medical and emergency services (Mudgee District Hospital, police station, etc). Additionally, Mudgee Airport operates as a regional airport within NSW's Mid-Western Region. Fly Pelican operates weekly return flights to Sydney and select regional centres.
Gulgong	Gulgong, a township of approximately 2,000 persons (rounded) (ABS ERP 2022) is in Mid-Western Regional LGA and is situated 45-minutes (drive-time) southeast of the Project Site. Founded as a gold mining settlement, the township today predominantly functions as a service hub for local agricultural activities and has a tourism role due to its historic features. Gulgong offers a mix of facilities and services, including: • Commercial accommodation – a range of establishments with the largest containing 36 rooms (Ten Dollar Town Motel). • Automotive mechanics. • Industry – Almac Hardware & Welding Supplies, Ace Engineering, R & J Andrews Haulage. • Supermarket – Supa IGA. • A range of cafes and bakeries. • Commonwealth Bank branch. • Fuel Supplies (Shell and BP). • Postal service. • Pharmacy. • Entertainment (parks, hotels, clubs, sports, and recreational activities – swimming pool, bowls club etc). • Gulgong District Hospital – medium sized local hospital. • Education – primary and secondary schools (both public) and an independent primary school.
Rylstone	Rylstone, with a population of approximately 660 persons (ABS ERP 2022), is located 70 km to the southeast of the Project Site or a 70-minute drive-time. Rylstone is a small township located along the Cudgegong River and traditionally known for its history including gold mining and agriculture. Key services in Rylstone include: • A limited range of commercial accommodation options. • Rylstone District Hospital – a moderate sized regional hospital. • Supermarkets and grocers – a small convenience grocer (Foodworks and Liquor), butcher and bakery. • Entertainment and Dining – various small cafes, Rylstone Club (sports club social and bowls club) and two hotels. • Fuel supplies – Enhance and Shell. • Postal Services.

Regional Centre of Township (by LGA)	Description of services
	• Education – Rylstone Public School. • Rylstone aerodrome. Service industry in Rylstone is limited, as the township is principally residential in nature and mainly supports agricultural activities for the wider municipality.

6.14.2. Potential Impacts

6.14.2.1. Project Investment

The total construction cost for the project is estimated to be approximately $800 million, according to the Project's Capital Investment Value report (RPS 2023). Major investment costs are associated with the purchase of WTGs and associated equipment, substation components etc, although significant investment is also required for civil, electrical and grid connection works.

Typically, around 15% of construction investment is generally retained within the host Study Area for these types of projects. This is based on unpublished confidential engineering, procurement, and construction (EPC) information from a range of renewable energy projects in Australia accessed by the consultant in the course of undertaking many economic impact assessments for renewable energy projects in the last 10 or so years.

Applying this ratio to total investment indicates approximately $120 million in wages, contracts and other service provision may be generated for the Study Area's economy over the 24-month construction phase.

6.14.2.2. Project Employment (Construction Phase)

Project employment is assessed in terms of direct jobs (i.e., site-related) and indirect (or flow-on) jobs in the local and wider economies (i.e., jobs that are supported through the industrial and consumption impacts of the initial investment).

DIRECT CONSTRUCTION EMPLOYMENT

Data provided by the Proponent indicates 250 Full Time Equivalent (FTE) jobs will be supported over the construction phase, which is expected to be up to 2-years (or 24 months). That is, on average 250 FTE jobs will be sustained for each of the 24 months of construction activities. However, actual workforce numbers will vary from month to month depending on the intensity of construction at the time. At the Project's peak, which may last for several months, the Proponent estimates 375 FTE positions will be supported by on-site construction activities.

Based on the Proponent's and Ethos Urban's experience in wind farm construction projects in similar rural locations, the following employment split is considered realistic:

- 25% or an average of 65 FTE jobs are expected to be sourced from within the Study Area (local employment), rising to 95 FTE local jobs at the Projects peak.
- 75% or an average of 190 FTE jobs are expected to be sourced from outside the Study Area (non-local employment), rising to 280 FTE non-local jobs at the Projects peak.

Note, sourcing 25% of the construction workforce locally should be considered a target rather than a commitment by the Proponent, given the low unemployment rate in the Study Area.

Construction-related jobs are expected to be associated with a wide-range of on and off-site activities, including:

- Labour recruitment
- Training
- Installation of WTG foundations
- Vehicle and equipment hire
- Earthworks
- Foundations
- Engineering services
- Roads and access tracks
- Transport and logistics
- Assembly and installation of WTG components
- Electrical works (cabling and connections)
- Installation of monitoring equipment
- Fencing
- Landscaping
- Security
- Waste disposal
- Business and financial services
- Administrative services.

As highlighted in Section 6.14.1, the business structure of the Study Area indicates that a reasonable mix of these types of services is available, especially in Dubbo and Mudgee.

INDIRECT CONSTRUCTION EMPLOYMENT

In addition to direct employment, significant employment will be supported indirectly through the employment multiplier effect. By applying an industry-standard multiplier for the construction industry of 1.6 (based on ABS Type B multipliers), the Project is estimated to generate an additional 400 FTE jobs on average over the construction period.

Indirect or flow-on jobs (which captures industry and consumption effects) include those supported locally and in the wider economy (including within other parts of NSW, and nationally), as the economic effects of the capital investment flow through the economy. Indirect employment creation in local and regional economies includes jobs supported through catering, accommodation, trade supplies, fuel supplies, transportation, food, and drink etc.

For the purposes of this assessment, it is assumed 20% of indirect jobs or 80 FTE jobs (rounded) are retained by people already located within in the Study Area because of the Project. This assumption is made with reference to findings from completed renewable energy projects in regional areas, where generally 20% of indirect jobs are retained by people within the study area and noting the significant influx of non-local workers (and their spending) likely to be associated with the Project.

TOTAL CONSTRUCTION EMPLOYMENT

Approximately 650 FTE jobs (250 FTE direct jobs and 400 FTE indirect jobs) are expected to be supported by the Project during the 24-month construction phase. The amount of direct Study Area employment (i.e., related to on-site construction activities) required for the Project is estimated to be approximately 65 FTE jobs (or 25% of the construction workforce), with a further 80 FTE jobs supported indirectly in the Study Area (i.e., off-site through supply chains and consumption activities).

6.14.2.3. Project Employment (Operational Phase)

DIRECT OPERATIONAL EMPLOYMENT

The Proponent indicates that 12 FTE direct jobs will be supported locally (on-site) on an ongoing basis through the operation and maintenance of the Project. These jobs include general managing roles, civil maintenance, and electricians.

INDIRECT OPERATIONAL EMPLOYMENT

Several additional jobs will also be supported indirectly through the employment multiplier effect. By applying an industry-standard multiplier for the electricity industry of 2.9 (based on ABS Type B multipliers) to the direct operational and maintenance jobs, a further 35 FTE ongoing jobs (rounded) would be supported in the wider State and national economies, with some of these jobs supported locally through operational supply chains and consumption impacts.

For the purposes of this assessment, it is assumed that 20% of indirect operational jobs are created in the Study Area (refer to previous assumption). This equates to approximately 7 ongoing FTE Study Area positions. Operational-related employment is for the lifetime of the Project (i.e., 30 years); therefore, while ongoing job creation is relatively small, it represents new long-term employment opportunities at a local, regional, and national level.

TOTAL OPERATIONAL EMPLOYMENT

In summary, approximately 47 FTE jobs (12 FTE direct and 35 FTE indirect) are expected to be supported by the Project, with 19 FTE positions supported in the Study Area.

6.14.2.4. Labour Force and Business Participation

Large infrastructure projects located in regional areas are, where possible, serviced locally or from within the immediate region due to cost efficiencies (lower transport, labour costs etc). Construction is a specialisation of the regional economy as indicated by the Study Area's workforce structure (by occupation and industry).

The anticipated number of direct and indirect Economic Study Area jobs (145 FTE workers) represents only 1.2% of the Study Area's labour force in construction-related activities (12,600 workers), noting that many of the indirect jobs will be supported in non-construction sectors (e.g., services sector) and that the Economic Study Area represents the Dubbo and Mid-Western LGAs.

The Study Area also has approximately 1,460 unemployed labour force participants, some of whom could work on the project and/or other major infrastructure projects (subject to suitable skills mix). Alternatively, unemployed jobseekers may play a 'backfill' role in the labour market, engaging in jobs vacated by other workers transferring to employment on the project or other major infrastructure projects.

In isolation, the workforce requirement of 145 FTE workers should not present a constraint to labour supply for the Project, in view of regional labour market. However, potential does exist for labour market constraints due to the cumulative impacts of multiple concurrent renewable and other large infrastructure projects in the region.

Given a level of uncertainty exists regarding labour force and supplier availability in the Study Area due to identified cumulative impacts together with the desire to maximise local inputs, the Proponent may consider preparing a workforce plan/strategy to guide the sourcing of local employment and suppliers based on market conditions in the lead up to the construction phase of the project commencing.

6.14.2.5. Housing and Commercial Accommodation

It is anticipated that 280 non-local FTE workers may need to be accommodated in the region at the Project's peak. This calculation is based on 75% of the 375 peak on-site FTE workers coming from outside the Study Area and requiring accommodation. This level of accommodation relates to the Project's peak only, which might last for several months. The average number of non-local staff requiring accommodation across the 24 months is estimated at 190 FTE workers (noting this number will be much lower during periods of low site activity).

These temporarily relocating staff are likely to include general managers, project managers, supervising engineers, and Wind specialists. Contract lengths will vary. This highlights the need for a range of accommodation types including higher-end options for staff on longer contracts, to convenient low-cost options for those on short-term contracts.

The Study Area currently has a capacity of approximately 830 rooms and cabins in commercial accommodation in locations within a 70-minute drive of the Project Area. Assuming each non-local worker requires individual accommodation (280 rooms), 34% of this accommodation stock would be required at peak times to service the Project if all workers chose this type of accommodation. However, this requirement is likely to be much lower as many workers are likely to choose to be accommodated in caravan/holiday parks (powered sites), shared private long and short-term rentals (e.g., vacant houses, holiday homes, Airbnb properties) or stay with family or friends (where possible) rather than in commercial accommodation. Additionally, other workers may share motel rooms/cabins etc to reduce personal costs. Currently there are 790 private short-term rentals on the market in the Study Area, potentially yielding 2,090 rooms; while an additional 3,320 unoccupied dwellings are also in the Study Area, some of which may be released to the market to support the Project (Ethos Urban, 2023b).

While this data indicates that reasonable capacity currently exists in the Study Area to accommodate the number of non-local workers expected at the peak of the Project, increased demand from concurrent regional infrastructure projects and seasonal accommodation demands (tourism, agricultural and mining activities etc) also need to be factored in.

The potential for local holiday parks in the Lake Burrendong area with excess capacity to accommodate some project workers is an aspect that may be considered by a workforce strategy/plan. The Proponent is investigating the possibility that the nearby Cudgegong River Holiday Park could be upgraded (subject to planning approval) to accommodate the majority of non-local construction workforce. Should the Cudgegong River Holiday Park (or a similar facility) be used to accommodate most non-local workers, it would be prudent that this results in a contribution of additional beds and/or upgraded facilities that can benefit Study Area's visitor/tourism sector in the long-term

6.14.2.6. Local Wage Spending Stimulus

Construction employment targets indicate that 75% of the 250 direct FTE construction jobs (190 FTE workers) may need to be sourced from outside the Study Area, particularly specialist and management positions. This level of employment would equate to $28.4 million in wages (2023 dollars) on the basis that each non-local worker is employed for 24 months and earns the average construction wage of $101,000 pa (ABS, 2022).

A considerable portion of these wages would be spent in the Study Area, where these workers will be based. An estimated $21.4 million in wages (2023 dollars) would likely be directed to local and regional businesses and service providers during the construction period. This estimate is based on reference to the ABS Household Expenditure Survey which indicates that approximately 75% of post-tax wages are likely to be spent by workers in the regional economy in view of the wide range of goods and services available in the Study Area. This spending would include the following:

- Housing expenditure, including spending on accommodation at hotels, motels, caravan/holiday parks, B&Bs, and private rental dwellings
- Retail expenditure, including spending on supermarket items, clothing, books, homewares etc.
- Recreation spending associated with day trips and excursions, gaming (lottery, sports betting, etc), purchases in pubs and clubs (although noting that expenditures at restaurants is included in the retail category)
- Personal, medical, and other services, such as GP fees and local prescriptions, fuel, vehicle maintenance and so on.

This level of personal spending would generate the equivalent of approximately 53 FTE jobs in the services sector and associated supply chains (based on 1 FTE job allocated for every $200,000 of induced spending), supporting jobs in the Study Area and beyond such as in retail, accommodation, trade supplies, health services, fuel supplies, cafes, and restaurants etc.

6.14.2.7. Agricultural Impacts

The Project is proposed on approximately 29,500 ha of existing agricultural land that is used primarily for sheep grazing. The Development Footprint would involve the use of 781 ha of agricultural land to be used for hosting WTG infrastructure. No loss of agricultural enterprise because of the Project is anticipated, either directly or through the supply chain, as grazing and other agricultural practices can continue within the majority of the Project Site. The new mixed-use arrangement is likely to require a similar number of employees as the present setup.

Additionally, 79 km of new internal tracks will be constructed across the Project Site providing productivity and safety benefits to host farmers.

6.14.2.8. Ongoing Economic Stimulus

FINANCIAL RETURNS TO LANDOWNERS

The Proponent will be leasing the land to host the Project. While these annual lease payments are confidential, they may provide a local stimulus through investment in farming (or other) activities and through business and individual consumption impacts associated with the host landowners.

FINANCIAL RETURNS TO THE COMMUNITY

The Proponent will make payments of approximately $3,000 per WTG per year ($210,000 in year 1 + CPI beyond) as contribution to the community to each of the Councils associated with the Project. Based on an operating lifespan of 30 years $10 million is estimated be paid to both Councils over the life of the Project. Note, a mechanism to distribute these funds to the community has yet to be decided.

FINANCIAL RETURNS TO COUNCIL

The change in land use to facilitate development of the Project will result in an increase in annual land tax payments to each Council, compared to current rates associated with existing land uses. The amount payable will be subject to discussions between the Proponent and each of the Councils.

The Proponent will also pay each Councils to upgrade the local roads to facilitate efficient delivery of wind WTG components to the site during construction.

LOCAL OPERATIONAL STIMULUS

The Project will support 19 FTE jobs in the Study Area (direct and indirect). These 19 FTE jobs will provide an estimated stimulus within the Study Area of approximately $1.2 million (2023 dollars) in Year 1 of operations. This figure assumes there will be no loss in direct or indirect agricultural jobs associated with the use of part of the land to host the Project (i.e., existing agricultural activities will continue on the remainder of the land and around project infrastructure). Over the 30-year lifespan of the project, the 19 local jobs supported by the project will generate economic stimulus of $58.5 million.

TOTAL OPERATIONAL STIMULUS

The total economic stimulus associated with the operation of the Project is estimated at approximately $190 million over 30 years, (2023 dollars, CPI adjusted) relating to operational wage stimulus and community payments.

6.14.2.9. National Grid Supply Benefits

With an installed capacity of 450 MW, the Project has the potential to provide sufficient renewable energy to support the annual electricity needs of the equivalent of approximately 120,000 NSW households, according to information provided by the Proponent. To provide context and theoretical perspective on the scale of the anticipated output from the Wind farm, the Study Area currently contains approximately 32,240 dwellings (ABS Census 2021); therefore, the Project has the potential to provide over four times the annual electricity requirements of the Study Area, highlighting the importance of the facility from a clean electricity generation perspective.

The Project will provide renewable energy contributing to the reduction of greenhouse gases across NSW, avoiding up to 900,000 tonnes p.a.

6.14.2.10. Tourism Opportunities

Over time, the Project may provide opportunities to attract new visitors to the area to view the facility. It is also noted that there is several existing/approved or planned utility scale renewable energy facilities in the broader region (stimulated by developer interest in the Central West and Orana REZ) which may provide opportunities for linked tours to these facilities. Visitors might include environmentalists, schools and further education students, general tourists etc.

The benefits of attracting new visitors to the area include increased expenditures on accommodation, food and beverage, fuel, retail, entertainment etc, all of which will support businesses and employment, especially in nearby townships such as Wellington, Gulgong, and Mudgee.

6.14.2.11. State-wide Benefits

In addition to supporting NSW State Policy directions and national grid supply benefits, the Project will deliver the following key Statewide economic benefits:

- Capital investment of $320 million, or 40% of total Project capital investment into the state (recognising the large import component associated with wind farms).
- Construction employment of 880 FTE jobs, or 90% of total construction employment (direct and indirect of peak employment).
- Ongoing employment of 42 FTE jobs, or 90% of total operating employment.
- Support for ongoing industry transition in Regional NSW from agriculture, mining, etc to renewable energy.
- Future decommissioning investment and employment opportunities, to be determined at a later date.

6.14.2.12. Project Decommissioning

The Project has an operating life of approximately 30 years, at which stage there are likely to be three (3) main options for consideration:

- Continue to use the Project Site as a wind farm using the existing infrastructure, potentially with some refurbishments.
- Replace/modernise all Project infrastructure and continue to operate as a new/significantly upgraded Wind Farm.
- Decommission the Project by removing all above ground infrastructure and rehabilitating the Project Site so the land can be returned to agricultural use.

The decision on whether to refurbish, replace or decommission the Project would be subject to an assessment of economic viability closer to the time, and in consultation with key stakeholders and approval authorities.

If decommissioning were to occur, these activities pose similar potential impacts and benefits as construction activities, albeit over a shorter timescale. Decommissioning activities would involve a significant on-site workforce to dismantle the infrastructure and other workers to transport of project components from the site for disposal or recycling. The site then would require a range of resources to undertake rehabilitation activities.

Decommissioning would therefore support significant employment, business contracts and provide a spending stimulus to the Study Area over the decommissioning period. Given decommissioning will not occur for at least 30 years after the operation of the Project commences, it is not possible to estimate potential impacts and benefits at this stage noting economic, technological, and environmental factors may change considerably over this period. Note however, the Proponent is committed to ensure as much infrastructure as possible is recycled upon decommissioning.

6.14.3. Mitigation Measures

Table 6-120 outlines the proposed measures to mitigate potential economic impacts.

Table 6-120: Mitigation Measures for Economic Impacts

Environmental Impact	Mitigation Measure	Reference Code
Construction Workforce and Accommodation	Implement measures to ensure that there is sufficient accommodation for the workforce associated with the construction phase of the Project (which may include a Workers Accommodation Facility or recommendation to invest in upgrades to Cudgegong River Holiday Park)	EC001
	Implement measures to address any specific cumulative impacts arising associated with other State Significant Development projects in the area	EC002
	Implement measures to prioritise the employment of local workers and the procurement of local businesses for the construction and operation of the Project	EC003
	Develop a program to monitor and review the effectiveness of the Strategy over the life of the Project, including regular monitoring and review during the construction phase	EC004
Community Benefit Sharing	Implement a community fund to be available to the wider community. This may include annual grants to local community organisations and specific programs. While guidelines and management structures for the operation of a community fund would need to be put in place; there is potential for this to be governed through a Voluntary Planning Agreement (VPA) with Council.	EC005

6.15 Cumulative Impacts

A Cumulative Impact Assessment was undertaken in accordance with the *Cumulative Impact Assessment Guidelines for State Significant Projects* (DPIE, 2021) and the requirements of the SEARs, which include:

- *an assessment of the likely impacts of all stages of the development (which is commensurate with the level of impact), including cumulative impacts of the development with existing and proposed developments in the region, in accordance with the Cumulative Impact Assessment Guideline (DPE), taking into consideration any relevant legislation, environmental planning instruments, guidelines, policies, plans and industry codes of practice and including the NSW Wind Energy Guideline for State Significant Wind Energy Development (2016);*

Assessment Overview

This section summarises the cumulative impacts from each environmental assessment and applies a category of Cumulative Impact Assessment (CIA) in accordance with the *Cumulative Impact Assessment Guidelines for State Significant Projects* (DPIE 2021). The Study Area selected for the CIA of each matter varied depending on the specific characteristics of the assessment and the scale and nature of the potential impacts on the matter resulting from the Project with other relevant future projects. The Study Area for each environmental matter has therefore been defined in Table 6-122

Key considerations for scoping the CIA are the relevant strategic planning frameworks, overlap in Study Area with other projects, the timing of construction, and the level of uncertainty. Cumulative impacts have been assigned one of three categories of assessment required for the environmental factor (Table 6-121).

The extent of cumulative impact assessment required was scoped by reviewing similar major projects, including renewable wind and solar projects, in the vicinity of the Project Site. The scoping activity looked at each other project's potential to co-occur, and the extent of potential impacts across the environmental factors assessed in this EIS. This scoping assessment, contained in Table 6-123, informed the level of assessment required based on the potential for cumulative impacts to occur.

6.15.1. Existing Environment

The Project is located within the proposed Central-West Orana REZ and more broadly, the highly productive agricultural central west region of NSW between Dubbo and Mudgee. As shown in Figure 2-5, there are several other existing and proposed renewable energy projects located within the REZ and broader area. When developing large scale projects such as the Project, consideration must be given to how that development will interact with other developments occurring in the area to better understand the potential impacts that may occur, including:

- Cumulative visual impacts as elements from multiple projects may be visible.
- Cumulative biodiversity impacts if habitat of or for threatened species is likely to be removed from multiple sites.
- Cumulative traffic impacts associated with compounding traffic needs by multiple projects potentially utilising rural roads.
- Cumulative hazard impacts because of changes to aerial operations or telecommunication impacts.
- Cumulative socio-economic impacts should multiple projects require accommodation or services at the same or similar times or increased employment demands.

In accordance with the *Cumulative Impact Assessment Guidelines for State Significant Projects* (DPIE, 2022), the Project has considered the potential impacts of the Project on key environmental factors discussed throughout Section 6 in relation to other projects identified in Table 2-1. These impacts were considered against key criteria to determine the level of assessment that is required as shown in Table 6-121.

Table 6-121: Cumulative impact assessment categories

Key	
Detailed Assessment	The Project may result in significant impacts on the matter, including cumulative impacts. Detailed assessment is characterised by: • potential overlap in impacts between a future project (e.g., Aquila Wind Farm) and the Project. • Potential for significant cumulative impacts because of the overlap, requiring detailed technical studies to assess the impacts. • Sufficient data is available on the future project to allow a detailed assessment of cumulative impacts with the Project for the relevant matter. • Uncertainties exist with respect to data, mitigation, assessment methods and criteria.
Standard Assessment	The Project is unlikely to result in significant impacts on the matter, including cumulative impacts. Standard assessments are characterised by: • Impacts are well understood. • Impacts are relatively easy to predict using standard methods. • Impacts are capable of being mitigated to comply with relevant standards or performance measures. • The assessment is unlikely to involve any significant uncertainties or require any detailed CIA.
No Assessment	No potential overlap in impacts between a future project and the Project that would warrant any consideration in the CIA.

6.15.2. Potential Cumulative Impacts

Table 6-122 summarises the defined study areas for each type of cumulative impact assessed below. The defined study areas are based on factors directly associated with the environmental impact assessed, such as the distance at which someone can distinguish a WTG within the landscape is generally accepted as 8 km, otherwise known as the viewshed principle. Other factors are harder to define geographically given the non-linear relationship to the potential impacts such as increased accommodation pressures of the presence of Aboriginal heritage values relative to the wider Wiradjuri Nation.

Table 6-122: Summary of defined Study Area for assessment for a given environmental factor

Environmental Factor	Defined Study Area	Other Projects within Defined Study Area
Landscape and Visual	8 km of WTG	• Central West Orana Transmission Link • Uungula Wind Farm • Aquila Wind Farm[11] • Piambong Wind Farm[14]
Noise and Vibration	5 km	Central West Orana Transmission Link
Biodiversity	Projects within 65 km that may similar threatened ecological communities and/or species.	• Uungula Wind Farm • Wellington Solar Farm • Wellington North Solar Farm • Maryvale Solar Farm • Suntop Solar Farm • Beryl Solar Farm • Tallawang Solar Farm • Spicers Creek Wind Farm • Sandy Creek Solar Farm • Wellington Road Solar Farm.
Traffic and Transport	Roads identified in Table 6-45including: • Saxa Road (Regional) • Hill End Road (Regional) • Goolma Road (State) • Golden Highway (State) • Castlereagh Highway (State) • Mitchell Highway (State).	• Central West Orana Transmission Link • Uungula Wind Farm • Barney Reef Wind Farm • Spicers Creek Wind Farm • Bellambi Heights Solar Farm • Beryl Solar Farm • Burrundulla Solar Farm • Maryvale Solar Farm • Sheraton Road Solar Farm • Tallawang Solar Farm • Wellington Road Solar Farm.
Hazards and Risks	**Telecommunications:** • 2 km of WTG (except GNSS) • 20 km of WTG for GNSS **Bushfire:** • 5 km	• Central West Orana Transmission Link (all) • Uungula Wind Farm (Aviation, Telecommunictions) • Wellington Solar Farm (Telecommunications) • Wellington North Solar Farm (Telecommunications)

[11] *The LVIA (MLA, 2023; Appendix F) notes that the Aquila Wind Farm and Piambong Wind Farm have both been proposed in proximity to the Project and are in the early planning stages and have not provided a project layout to assess potential visual impacts. As such, a detailed assessment of cumulative visual impacts from the two projects will be required as part of the Aquila and Piambong Wind Farm submissions, not this EIS.*

Environmental Factor	Defined Study Area	Other Projects within Defined Study Area
	Aviation: • 56 km (30 nm)[12]	• Maryvale Solar Farm (Telecommunications) • Suntop Solar Farm (Telecommunications) • Spicers Creek Wind Farm (Aviation) • Barney Reef Wind Farm (Aviation).
Aboriginal Heritage	Project Site	Central West Orana Transmission Link
Historic Heritage	10 km	• Central West Orana Transmission Link • Burrendong Hydro Power Station • Uungula Wind Farm.
Soils, Land Use and Agricultural Land	Project Site	Central West Orana Transmission Link
Surface Water, Ground Water and Aquatic Ecology	Macquarie River Catchment, Cudegong River	• Central West Orana Transmission Link • Wellington Solar Farm • Wellington North Solar Farm • Maryvale Solar Farm • Geurie Solar Farm • Beryl Solar Farm • Bellambi Heights Solar Farm • Wellington Road Solar Farm • Stubbo Solar Farm • Dubbo Solar Farm • Sheraton Road Solar Farm.
Resource Requirements and Waste	150 km of Project Site	All projects listed in Table 6-124

Social	Project Site
	Community:
	• Yarragal
	• Yarrabin
	• Mumbil
	• Mookerawa
	• Wellington
	Region:
	• Dubbo LGA
	• Mid-Western LGA
		• Community:
		  o Burrendong Hydroelectric Power Station
		  o Uungula Wind Farm
		• Region: All projects listed in Table 6-124

Economic	Local Study Area: • Dubbo LGA • Mid-Western LGA Regional Study Area: • Central West and Orana Renewable Energy Zone	All projects listed in Table 6-124

[12] Only wind farms have been considered within the 56 km study area as other projects, such as solar farms, within that area will not impact on aviation operations or require assessment of impacts to aerial operations.

Table 6-123: Cumulative impact assessment scoping summary

Standard Assessment Required	The Project is unlikely to result in significant impacts on the matter, including cumulative impacts
No Assessment Required	No potential overlap in impacts between a future project and the proposed project warranting consideration

Existing of Future Projects	Approx. Distance to Project	Project Status, Indicative Timing and Overlap	Potential Overlap between Impact of the Project on Assessment matter and the Impact of other Projects on the Same Assessment Matter									
			Relevant Assessment Matters									
			Landscape and Visual	Noise and Vibration	Biodiversity	Hazards and Risks	Aboriginal and Historic Heritage	Traffic and Transport	Soils, Land Use and Agricultural	Surface Water and Groundwater	Resource Requirements and Waste	Social & Economic
Central West & Orana REZ 500 kV Transmission Link	-	Proposed	Potential for limited cumulative impact where both transmission line infrastructure and some WTGs will be visible concurrently in the landscape. However, given the early proposed nature of the transmission link, as of August 2023, the location of infrastructure associated with the link is unknown and therefore difficult to determine the extent of visual impacts that may occur.	Unlikely for cumulative noise impacts to occur above the minimum noise criteria outlined in the Noise Bulletin (DPE, 2016c).	Potential for Box Gum Woodland to be recorded within Transmission link project disturbance area requiring removal, listed under the BC Act and EPBC Act. However, will be unknown until ecology assessment undertaken for the Link. No information available on potential Species Credit Species within the site.	Telecommunications: Potential cumulative telecommunication impacts from additional infrastructure between radar/weather stations Bushfire: N/A Aviation: N/A	Potential for additional impacts to Aboriginal cultural heritage values within the Project Site because of Transmission Link infrastructure.	The Central West & Orana Transmission Link is currently only proposed and will not significantly contribute to traffic impacts during Project construction given different timeframes.	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil or landform impacts between the Transmission Link and the Project.	Macquarie River Catchment, however cumulative impacts unlikely.	No overlapping construction period expected, resulting in no cumulative waste impacts as the Project will likely be constructed before transmission link begins.	No cumulative impacts anticipated besides the Project assisting the transmission link with renewable energy and generating positive social and economic outcomes.
Burrendong Hydro Power Station The Project is an operational hydroelectric dam that generates approximately 19 MW of output via water leaving the dam through turbines.	6 km north-west	Operational	The Burrendong Hydro Power Station is an existing low-lying structure on the south west of Lake Burrendong. No cumulative impacts are anticipated.	Cumulative noise impacts are unable to occur at the distances between the Burrendong Hydro Power Station and the Project.	No cumulative impact given the Burrendong Hydro Power Station is an existing facility.	Telecommunications: N/A Bushfire: N/A Aviation: N/A	No cumulative impact given the Burrendong Hydro Power Station is an existing facility.	The Burrendong Hydro Power Station is currently in operation and will not significantly contribute to traffic impacts during Project construction	No cumulative impact given the Burrendong Hydro Power Station is an existing facility.	The nature of the Burrendong Hydro Power Station is unlikely to cause cumulative water impacts regarding the Project.	No cumulative impact given the Burrendong Hydro Power Station is an existing facility.	No cumulative impact given the Burrendong Hydro Power Station is an existing facility.
Uungula Wind Farm The Project is an approved wind farm of up to 93 WTGs that will generate approximately 414 MW of energy.	8.78 km south	Approved	Cumulative impacts anticipated at a small number of non-involved dwellings and	Cumulative noise impacts may occur within an area of overlapping noise contours	The Uungula Wind Farm recorded Box Gum Woodland, listed under both the BC Act and EPBC	Telecommunications: N/A Bushfire: N/A Aviation: N/A	Bushfire: N/A Aviation: N/A No identified archaeological / cultural heritage	Potential for simultaneous use of major road network for transport of materials and workforce expected	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%.	Small creeks and tributaries flow into Lake Burrendong with the potential for	Potential for limited cumulative resource and waste facility requirements from both the Project and	Positive social and economic outcomes at community scale, with the potential for

Existing of Future Projects	Approx. Distance to Project	Project Status, Indicative Timing and Overlap	Potential Overlap between Impact of the Project on Assessment matter and the Impact of other Projects on the Same Assessment Matter									
			Relevant Assessment Matters									
			Landscape and Visual	Noise and Vibration	Biodiversity	Hazards and Risks	Aboriginal and Historic Heritage	Traffic and Transport	Soils, Land Use and Agricultural	Surface Water and Groundwater	Resource Requirements and Waste	Social & Economic
			public viewpoints based on worst case scenario. Detailed visual assessment undertaken in LVIA (Appendix F). Some impacts to be mitigated by existing topography.	of the Uungula Wind Farm and the Project. However, the NVIA (MDA, 2023; Appendix G) determined noise levels to still be below the minimum set out in the Noise Bulletin (DPE, 2016c).	Act. TEC removal totals 23.4 ha Potential for five (5) species credit species to overlap between the Project and the Uungula Wind Farm: • *Swainsona recta* • *Swainsona sericea* *Phascolarctos cinereus* • *Cercartetus nanus* • *Petaurus norfolcensis*		constraints given the distance between the Uungula Wind Farm and the Project.	during months 9 and 10. However, it is assumed Uungula WF will be operational during Project construction (Stantec, 2023).	No expected soil or landform impacts between the Uungula Wind Farm and the Project.	cumulative water impacts to occur.	the Uungula Wind Farm.	some negative cumulative social outcomes related to social amenity as discussed in LVIA and SIA. Positive social and economic benefits because of cumulative projects within the regional study area.
Wellington Solar Farm The Project proposes to develop approximately 200 MW of output via Photo Voltaic solar panels	11.10 km south east	Operational.	No cumulative impacts expected given the viewshed principle and the Wellington Solar Farm outside the determined study area (8 km from a WTG).	Cumulative noise impacts will not occur at the distances between the Wellington Solar Farm and the Project.	Also recorded White Box Gum Woodland, listed under both the BC Act and EPBC Act. EEC removal totals 7.12 ha No Species Credit Species overlap anticipated	Telecommunications: Potential for multiple projects intersecting GNSS links though considered unlikely given the low height of solar farms relative to the stations. Bushfire: N/A Aviation: N/A	No identified archaeological / cultural heritage constraints given the distance between Wellington Solar Farm and the Project.	Wellington Solar Farm is currently in operation and will not significantly contribute to traffic impacts during Project construction	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil or landform impacts between the Wellington Solar Farm and the Project	Macquarie River Catchment, however cumulative impacts unlikely.	No overlapping construction period resulting in no cumulative waste impacts from both the Project and the Wellington Solar Farm.	Positive social and economic benefits because of cumulative projects within the regional study area.
Wellington North Solar Farm The Project proposes to develop approximately 400 MW of output via Photo Voltaic solar panels	13.22 km southeast	Under Construction.	No cumulative impacts expected given the viewshed principle and the Wellington North Solar Farm outside the determined study area (8 km from a WTG).	Cumulative noise impacts are unable to occur at the distances between the Wellington North Solar Farm and the Project.	Also recorded White Box Gum Woodland, listed under both the BC Act and EPBC Act. EEC removal totals 197.9 ha Potential for ten (10) Species Credit Species to overlap between the Project and the Wellington North Solar Farm: • *Swainsona recta* • *Swainsona sericea* • *Euphrasia arguta* • *Aprasia parapulchella* • *Cercartetus nanus* • *Crinia sloanei*	Telecommunications: Potential for multiple projects intersecting GNSS links though considered unlikely given the low height of solar farms relative to the stations. Bushfire: N/A Aviation: N/A	No identified archaeological / cultural heritage constraints given the distance between the Wellington North Solar Farm and the Project.	The project is currently under construction and will not significantly contribute to traffic impacts during Project construction	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil or landform impacts between the Wellington North Solar Farm and the Project.	Macquarie River Catchment, however cumulative impacts unlikely.	No overlapping construction period resulting in no cumulative waste impacts from both the Project and the Wellington North Solar Farm.	Positive social and economic benefits because of cumulative projects within the regional study area.

Existing of Future Projects	Approx. Distance to Project	Project Status, Indicative Timing and Overlap	Potential Overlap between Impact of the Project on Assessment matter and the Impact of other Projects on the Same Assessment Matter									
			Relevant Assessment Matters									
			Landscape and Visual	Noise and Vibration	Biodiversity	Hazards and Risks	Aboriginal and Historic Heritage	Traffic and Transport	Soils, Land Use and Agricultural	Surface Water and Groundwater	Resource Requirements and Waste	Social & Economic
					• *Ninox connivens* • *Petaurus norfolcensis* • *Phascogale tapoatafa* • *Tyto novaehollandiae*							
Maryvale Solar Farm The Project proposes to develop approximately 125 MW of output via Photo Voltaic solar panels, with the potential to increase to 230 MW, dependent on approval of development consent modification.	18.7 km southeast	Approved.	No cumulative impacts expected given the viewshed principle and the Maryvale Solar Farm outside the determined study area (8 km from a WTG).	Cumulative noise impacts are unable to occur at the distances between the Maryvale Solar Farm and the Project.	Also recorded White Box Gum Woodland, listed under both the BC Act and EPBC Act. EEC removal totals 1.2 ha. No Species Credit Species overlap anticipated.	Telecommunications: Potential for multiple projects intersecting GNSS links though considered unlikely given the low height of solar farms relative to the stations. Bushfire: N/A Aviation: N/A	No identified archaeological / cultural heritage constraints given the distance between the Maryvale Solar Farm and the Project.	Potential for simultaneous use of major road network for transport of materials and workforce expected during months 9 and 10. However, it is assumed Maryvale Solar Farm will be operational during Project construction (Stantec, 2023).	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil or landform impacts between the Maryvale Solar Farm and the Project.	Macquarie River Catchment, however cumulative impacts unlikely.	Potential for limited cumulative resource and waste facility requirements from both the Project and the Maryvale Solar Farm.	Positive social and economic benefits because of cumulative projects within the regional study area.
Suntop Solar Farm The Project proposes to develop approximately 198 MW of output via Photo Voltaic solar panels.	20 km east	Operational.	No cumulative impacts expected given the viewshed principle and the Suntop Solar Farm outside the determined study area (8 km from a WTG).	Cumulative noise impacts are unable to occur at the distances between the Suntop Solar Farm and the Project.	Also recorded White Box Gum Woodland, listed under both the BC Act and EPBC Act. EEC removal totals 0.4 ha. No Species Credit Species overlap anticipated.	Telecommunications: N/A Bushfire: N/A Aviation: N/A	No identified archaeological / cultural heritage constraints given the distance between the Suntop Solar Farm and the Project.	Suntop Solar Farm is currently in operation and will not significantly contribute to traffic impacts during Project construction	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil or landform impacts between the Suntop Solar Farm and the Project.	N/A	No overlapping construction period resulting in no cumulative waste impacts from both the Project and the Suntop Solar Farm.	Positive social and economic benefits because of cumulative projects within the regional study area.
Bodangora Wind Farm The Project is an operational wind farm that generates approximately 113 MW of output via Wind Turbine Generators.	21.96 km southeast	Operational.	No cumulative impacts expected given the viewshed principle and the Bodangora Wind Farm outside the determined study area (8 km from a WTG).	Cumulative noise impacts are unable to occur at the distances between the Bodangora Wind Farm and the Project.	Information not available.	Telecommunications: N/A Bushfire: N/A Aviation: Potential need to alter aerial routes, LSALT and/or PANS OPS depending on multiple projects with WTGs above a certain AHD.	No identified archaeological / cultural heritage constraints given the distance between Bodangora Wind Farm and the Project.	Bodangora Wind Farm is currently in operation and will not significantly contribute to traffic impacts during Project construction	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil or landform impacts between the Bodangora Wind Farm and the Project.	N/A	No overlapping construction period resulting in no cumulative waste impacts from both the Project and the Bodangora Wind Farm.	Positive social and economic benefits because of cumulative projects within the regional study area.
Burrundulla Solar Farm The Project proposes to develop approximately electricity output via Photo Voltaic solar panels.	24.23 km southwest	In Planning.	No cumulative impacts expected given the viewshed principle and the Burrundulla Solar	Cumulative noise impacts are unable to occur at the distances between the	Information not available.	Telecommunications: N/A Bushfire: N/A Aviation: N/A	No identified archaeological / cultural heritage constraints given the distance between the	Potential for simultaneous use of major road network for transport of materials and workforce, with	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%.	N/A	Potential for limited cumulative resource and waste facility requirements from both the Project and	Positive social and economic benefits because of cumulative projects within

Existing of Future Projects	Approx. Distance to Project	Project Status, Indicative Timing and Overlap	Potential Overlap between Impact of the Project on Assessment matter and the Impact of other Projects on the Same Assessment Matter								
			Relevant Assessment Matters								
			Landscape and Visual	Noise and Vibration	Biodiversity	Hazards and Risks	Aboriginal and Historic Heritage	Traffic and Transport	Soils, Land Use and Agricultural	Surface Water and Groundwater	Resource Requirements and Waste	Social & Economic
However, changes to NSW SEPPs in 2022 may result in the project not being approved.			Farm outside the determined study area (8 km from a WTG).	Burrundulla Solar Farm and the Project.			Burrundulla Solar Farm and the Project.	limited traffic impacts from construction of both Burrundulla Solar Farm and the Project.	No expected soil or landform impacts between the Burrundulla Solar Farm and the Project		the Burrundulla Solar Farm.	the regional study area.
Geurie Solar Farm The Project proposes to develop approximately 5 MW of output via Photo Voltaic solar panels as well as an undetermined Battery Energy Storage System.	25.50 km southeast	Approved.	No cumulative impacts expected given the viewshed principle and the Geurie Solar Farm being outside the determined study area (8 km from a WTG).	Cumulative noise impacts are unable to occur at the distances between the Geurie Solar Farm and the Project.	Information not available.	Telecommunications: N/A Bushfire: N/A Aviation: N/A	No identified archaeological / cultural heritage constraints given the distance between Geurie Solar Farm and the Project.	Potential for simultaneous use of major road network for transport of materials and workforce, with limited traffic impacts. However, it is assumed Geurie Solar Farm will be operational during Project construction (Stantec, 2023).	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil or landform impacts between the Geurie Solar Farm and the Project.	Macquarie River Catchment, however cumulative impacts unlikely.	Unlikely to have construction overlap which places cumulative strain on resource and waste facilities from both the Project and the Geurie Solar Farm.	Positive social and economic benefits because of cumulative projects within the regional study area.
Beryl Solar Farm The Project proposes to develop approximately 109 MW of output via Photo Voltaic solar panels.	35.54 km southeast	Operational.	No cumulative impacts expected given the viewshed principle and the Beryl Solar Farm being outside the determined study area (8 km from a WTG).	Cumulative noise impacts are unable to occur at the distances between the Beryl Solar Farm and the Project.	Also recorded White Box Gum Woodland, listed under both the BC Act and EPBC Act. EEC removal totals 17.13 ha No Species Credit Species overlap anticipated	Telecommunications: N/A Bushfire: N/A Aviation: N/A	No identified archaeological / cultural heritage constraints the distance between the Beryl Solar Farm and the Project.	The project is currently in operation and will not significantly contribute to traffic impacts during Project construction	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil or landform impacts between the Beryl Solar Farm and the Project.	Cudgegong River Catchment, however cumulative impacts unlikely.	No overlapping construction period resulting in no cumulative waste impacts from both the Project and the Beryl Solar Farm.	Positive social and economic benefits because of cumulative projects within the regional study area.
Tallawang Solar Farm The Project proposes to develop approximately 550 MW of output via Photo Voltaic solar panels and 1000 MWh battery energy storage system.	37.97 km southeast	In Planning.	No cumulative impacts expected given the viewshed principle and the Tallawang Solar Farm being outside the determined study area (8 km from a WTG).	Cumulative noise impacts are unable to occur at the distances between the Tallawang Solar Farm and the Project.	Also recorded White Box Gum Woodland, listed under both the BC Act and EPBC Act. EEC removal totals 28.07 ha No Species Credit Species overlap anticipated	Telecommunications: N/A Bushfire: N/A Aviation: N/A	No identified archaeological / cultural heritage constraints given the distance between Tallawang Solar Farm and the Project.	Potential for simultaneous use of major road network for transport of materials and workforce, with limited traffic impacts.	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil or landform impacts between the Tallawang Solar Farm and the Project	N/A	Unlikely to have construction overlap which places cumulative strain on resource and waste facilities from both the Project and the Tallawang Solar Farm.	Positive social and economic benefits because of cumulative projects within the regional study area.
Bellambi Heights Solar Farm The Project proposes to develop approximately 200 MW of output via Photo Voltaic solar panels as well as a 200 MW Battery Energy Storage System.	38.79 km southeast	In Planning.	No cumulative impacts expected given the viewshed principle and the Bellambi Heights	Cumulative noise impacts are unable to occur at the distances between the	Information not available.	Telecommunications: N/A Bushfire: N/A Aviation: N/A	No identified archaeological / cultural heritage constraints given the distance between the	Potential for simultaneous use of major road network for transport of materials and workforce, with	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil	Cudgegong River Catchment, however cumulative impacts unlikely.	Unlikely to have construction overlap which places cumulative strain on resource and waste facilities from both	Positive social and economic benefits because of cumulative projects within

Existing of Future Projects	Approx. Distance to Project	Project Status, Indicative Timing and Overlap	Potential Overlap between Impact of the Project on Assessment matter and the Impact of other Projects on the Same Assessment Matter									
			Relevant Assessment Matters									
			Landscape and Visual	Noise and Vibration	Biodiversity	Hazards and Risks	Aboriginal and Historic Heritage	Traffic and Transport	Soils, Land Use and Agricultural	Surface Water and Groundwater	Resource Requirements and Waste	Social & Economic
			Solar Farm being outside the determined study area (8 km from a WTG).	Bellambi Heights Solar Farm and the Project.			Bellambi Heights Solar Farm and the Project.	limited traffic impacts.	or landform impacts between the Bellambi Heights Solar Farm and the Project.		the Project and the Bellambi Heights Solar Farm.	the regional study area.
Spicers Creek Wind Farm The Project proposes to develop approximately 700 MW of output via Wind Turbine Generators.	43.92 km south	In Planning.	No cumulative impacts expected given the viewshed principle and the Spicers Creek Wind Farm being outside the determined study area (8 km from a WTG).	Cumulative noise impacts are unable to occur at the distances between the Spicers Creek Wind Farm and the Project.	Also recorded White Box Gum Woodland, listed under both the BC Act and EPBC Act. EEC removal totals 44.3 ha. Potential for fifteen (15) Species Credit Species to overlap between the Project and Spicers Creek Wind Farm: • *Swainsona recta* • *Swainsona sericea* • *Diuris tricolor* • *Euphrasia arguta* • *Tylophora linearis* • *Phascolarctos cinereus* • *Burhinus grallarius* • *Cercartetus nanus* • *Crinia sloanei* • *Hoplocephalus bitorquatus* • *Keyacris scurra* • *Ninox connivens* • *Ninox strenua* • *Petaurus norfolcensis* • *Tyto novaehollandiae*	Telecommunications: N/A Bushfire: N/A Aviation: Potential need to alter aerial routes, LSALT and/or PANS OPS depending on multiple projects with WTGs above a certain AHD.	No identified archaeological / cultural heritage constraints given the distance between the Spicers Creek Wind Farm and the Project.	Potential for simultaneous use of major road network for transport of materials and workforce, with limited traffic impacts.	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil or landform impacts between the Spicers Creek Wind Farm and the Project.	N/A	Unlikely to have construction overlap which places cumulative strain on resource and waste facilities from both the Project and the Spicers Creek Wind Farm.	Positive social and economic benefits because of cumulative projects within the regional study area.
Sandy Creek Solar Farm The Project proposes to develop approximately 840 MW of output via Photo Voltaic solar panels and Battery Energy Storage System	45.92 km south	In Planning	No cumulative impacts expected given the viewshed principle and the Sandy Creek Solar Farm being outside the determined study area (8 km from a WTG).	Cumulative noise impacts are unable to occur at the distances between the Sandy Creek Solar Farm and the Project.	Also recorded White Box Gum Woodland, listed under both the BC Act and EPBC Act. EEC removal totals 353.58 ha Species Credit Species information unavailable.	Telecommunications: N/A Bushfire: N/A Aviation: N/A	No identified archaeological / cultural heritage constraints given the distance between the Sandy Creek Solar Farm and the Project.	Unlikely for simultaneous use of major road network for transport of materials and workforce.	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil or landform impacts between the Sandy Creek Solar Farm and the Project.	N/A	Unlikely to have construction overlap which places cumulative strain on resource and waste facilities from both the Project and the Sandy Creek Solar Farm.	Positive social and economic benefits because of cumulative projects within the regional study area.

Existing of Future Projects	Approx. Distance to Project	Project Status, Indicative Timing and Overlap	Potential Overlap between Impact of the Project on Assessment matter and the Impact of other Projects on the Same Assessment Matter									
			Relevant Assessment Matters									
			Landscape and Visual	Noise and Vibration	Biodiversity	Hazards and Risks	Aboriginal and Historic Heritage	Traffic and Transport	Soils, Land Use and Agricultural	Surface Water and Groundwater	Resource Requirements and Waste	Social & Economic
Wellington Road Solar Farm Information not available	47.10 km southeast	Approved	No cumulative impacts expected given the viewshed principle and the Wellington Road Solar Farm being outside the study area (8 km from a WTG).	Cumulative noise impacts are unable to occur at the distances between the Wellington Road Solar Farm and the Project.	Information Not Available	Telecommunications: N/A Bushfire: N/A Aviation: N/A	No identified archaeological / cultural heritage constraints given the distance between the Wellington Road Solar Farm and the Project.	Potential for simultaneous use of major road network for transport of materials and workforce, with limited traffic impacts because of the Wellington Road Solar Farm and the Project.	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil or landform impacts between the Wellington Road Solar Farm and the Project.	Macquarie River Catchment, however cumulative impacts unlikely.	Unlikely to have construction overlap which places cumulative strain on resource and waste facilities from both the Wellington Road Solar Farm and the Project	Positive social and economic benefits because of cumulative projects within the regional study area.
Stubbo Solar Farm The Project proposes to develop approximately 400 MW of output via Photo Voltaic solar panels	49.37 km southwest	Approved	No cumulative impacts expected given the viewshed principle and the Stubbo Solar Farm being outside the determined study area (8 km from a WTG).	Cumulative noise impacts are unable to occur at the distances between Stubbo Solar Farm and the Project.	Also recorded White Box Gum Woodland, listed under both the BC Act and EPBC Act. EEC removal totals 0.17 ha. Potential for four (4) Species Credit Species to overlap between the Project and Stubbo Solar Farm: • *Swainsona sericea* • *Aprasia parapulchella* • *Phascolarctos cinereus* • *Ninox connivens*	Telecommunications: N/A Bushfire: N/A Aviation: N/A	No identified archaeological / cultural heritage constraints given the distance between the Stubbo Solar Farm and the Project.	Unlikely for simultaneous use of major road network for transport of materials and workforce from both the Stubbo Solar Farm and the Project.	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil, landform impacts from both the Stubbo Solar Farm and the Project.	Cudgegong River Catchment, however cumulative impacts unlikely.	Unlikely to have construction overlap which places cumulative strain on resource and waste facilities from both the Stubbo Solar Farm and the Project	Positive social and economic benefits because of cumulative projects within the regional study area.
Dubbo Solar Farm The Project is an operational solar farm with 28 MW of output via Photo Voltaic solar panels.	51.15 km SE	Operational.	No cumulative impacts expected given the viewshed principle and the Dubbo Solar Farm being outside the determined study area (8 km from a WTG).	Cumulative noise impacts are unable to occur at the distances between the Dubbo Solar Farm and the Project.	Information not available	Telecommunications: N/A Bushfire: N/A Aviation: N/A	No identified archaeological / cultural heritage constraints given the distance between the Dubbo Solar Farm and the Project.	The project is currently in operation and will not significantly contribute to traffic impacts during Project construction.	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil or landform impacts between the Dubbo Solar Farm and the Project.	Macquarie River Catchment, however cumulative impacts unlikely.	No overlapping construction period resulting in no cumulative waste impacts from both the Dubbo Solar Farm and the Project	Positive social and economic benefits because of cumulative projects within the regional study area.
Ulan Solar Farm The Project proposes to develop approximately 50 MW of output via Photo Voltaic solar panels	54.22 km southwest	In Planning.	No cumulative impacts expected given the viewshed principle and the Ulan Solar Farm being outside the determined study	Cumulative noise impacts are unable to occur at the distances between the Ulan Solar Farm and the Project.	Information not available at the Request for SEARs stage.	Telecommunications: N/A Bushfire: N/A Aviation: N/A	No identified archaeological / cultural heritage constraints given the distance between the Ulan Solar Farm and the Project.	Unlikely for simultaneous use of major road network for transport of materials and workforce from both the Ulan Solar Farm and the Project.	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil or landform impacts between the Ulan Solar	N/A	Unlikely to have construction overlap which places cumulative strain on resource and waste facilities from both the Ulan Solar Farm and the Project.	Positive social and economic benefits because of cumulative projects within the regional study area.

Existing of Future Projects	Approx. Distance to Project	Project Status, Indicative Timing and Overlap	Potential Overlap between Impact of the Project on Assessment matter and the Impact of other Projects on the Same Assessment Matter									
			Relevant Assessment Matters									
			Landscape and Visual	Noise and Vibration	Biodiversity	Hazards and Risks	Aboriginal and Historic Heritage	Traffic and Transport	Soils, Land Use and Agricultural	Surface Water and Groundwater	Resource Requirements and Waste	Social & Economic
			area (8 km from a WTG).						Farm and the Project.			
Sheraton Road Solar Farm Information not available	54.36 km southeast	Approved.	No cumulative impacts expected given the viewshed principle and the Sheraton Road Solar Farm being outside the determined study area (8 km from a WTG).	Cumulative noise impacts are unable to occur at the distances between the Sheraton Road Solar Farm and the Project.	Information not available.	Telecommunications: N/A Bushfire: N/A Aviation: N/A	No identified archaeological / cultural heritage constraints given the distance between the Sheraton Road Solar Farm and the Project.	Potential for simultaneous use of major road network for transport of materials and workforce, with limited traffic impacts between the Sheraton Road Solar Farm and the Project.	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil or landform impacts between the Sheraton Road Solar Farm and the Project.	Macquarie River Catchment, however cumulative impacts unlikely.	Unlikely to have construction overlap which places cumulative strain on resource and waste facilities from both the Sheraton Road Solar Farm and the Project.	Positive social and economic benefits because of cumulative projects within the regional study area.
Barney Reef Wind Farm The Project proposes to develop approximately 440 MW of output via Wind Turbine Generators	55.22 km southwest	In Planning.	No cumulative impacts expected given the viewshed principle and the Barney Reef Wind Farm being outside the determined study area (8 km from a WTG).	Cumulative noise impacts are unable to occur at the distances between the Barney Reef Wind Farm and the Project.	Information not available at Request for SEARs stage.	Telecommunications: N/A Bushfire: N/A Aviation: Potential need to alter aerial routes, LSALT and/or PANS OPS depending on multiple projects with WTGs above a certain AHD.	No identified archaeological / cultural heritage constraints given the distance between the Barney Reef Wind Farm and the Project.	Unlikely for simultaneous use of major road network for transport of materials and workforce from both the Barney Reef Wind Farm and the Project.	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil or landform impacts between the Barney Reef Wind Farm and the Project.	N/A	Unlikely to have construction overlap which places cumulative strain on resource and waste facilities from both the Barney Reef Wind Farm and the Project.	Positive social and economic benefits because of cumulative projects within the regional study area.
Forest Glen Solar Farm The Project proposes to develop approximately 110 MW of output via Photo Voltaic solar panels	63.12 km southwest	Approved	No cumulative impacts expected given the viewshed principle and the Forest Glen Solar Farm being outside the determined study area (8 km from a WTG).	Cumulative noise impacts are unable to occur at the distances between the Forest Glen Solar Farm and the Project.	Burrendong Wind Farm related EECs not assessed within project site.	Telecommunications: N/A Bushfire: N/A Aviation: N/A	No identified archaeological / cultural heritage constraints given the distance between the Forest Glen Solar Farm and the Project.	Unlikely for simultaneous use of major road network for transport of materials and workforce from both the Forest Glen Solar Farm and the Project.	Limited reduction in cumulative agricultural land within REZ of approx. 0.1%. No expected soil or landform impacts between the Forest Glen Solar Farm and the Project.	N/A	Unlikely to have construction overlap which places cumulative strain on resource and waste facilities from both Forest Glen Solar Farm and the Project	Positive social and economic benefits because of cumulative projects within the regional study area.

6.15.2.1. Landscape and Visual

The development of Wind Farms in rural environments will inevitably alter the visual landscape to a certain degree. This can be exacerbated by successive projects within a given proximity to one another and may alter the overall landscape character. This is done for example when multiple projects are viewed successively from a roadway. The Project is located within the Central-West Orana REZ, where several other proposed renewable projects are in various stages of development are anticipated to occur. There are nine (9) proposed, approved, and constructed wind farms within the Central-West Orana REZ, with the Uungula Wind Farm located in close proximity to the Project as shown in Table 6-124.

Table 6-124: Overview of renewable energy projects within the Central West Orana REZ (MLA, 2023)

Renewable Project	Distance to the Project (approximate)	Project Size (* estimated)	Planning Status
		Operational Wind Farms	
Bodangora Wind Farm	24 km N	33 WTGs	Operational
		Approved Wind Farms	
Uungula Wind Farm	3.84 km N	97 WTGs*	Consent Granted: Mau 2021
Liverpool Range Wind Farm	94 km NE	267 WTGs*	Modification to Consent
		Proposed Wind Farms	
Barneys Reef Wind Farm	49 km NNE	65 WTGs*	SEARs issued: September 2021
Valley of the Winds Wind Farm	70 km NNE	140 WTGs*	EIS Lodged: February 2022
Kerrs Creek Wind Farm	22 km SW	Unknown	No SEARs issued as of July 2023
Spicers Creek Wind Farm	25 km N	117 WTGs*	SEARs received May 2022
Aquila Wind Farm	Unknown E	Unknown	No SEARs issued as of July 2023

As the Project is proposed in proximity to the approved Uungula Wind Farm to the north, with the nearest WTG proposed 3.84 km to the north of the Projects northern most WTG, cumulative impacts need to be considered on the landscape. The cumulative impacts of the Project with the Uungula Wind Farm were considered using the viewing shed principle, where features of a landscape, including WTGs are known to fade into the background at 8 km. Additional assessment of the cumulative impacts of the Project regarding other proposed wind farm projects in the REZ will be required during the submission of the respective projects, being the Aquila and Piambong Wind Farms as they are both in the planning stages and cumulative impacts are not currently assessable.

MULTIPLE WIND TURBINE TOOL

In accordance with the *Preliminary Assessment Tool: Multiple Wind Turbine*, an 8 km radius was applied to both the Uungula Wind Farm and the Project to identify any dwellings or viewpoints that may occur within 8 km. The dwellings and viewpoints are shown in Figure 6-78. The assessment identified that five (5) dwellings were located within 8 km of both the Uungula Wind Farm and the Project. However, the assessment undertaken by MLA (2023; Appendix F) determined that of the five (5) dwellings, only two (2) have the potential to view both the Uungula Wind Farm and the Project (L6-1, MLA-03 and MLA-05). Table 6-125 outlines the overview of cumulative visual impacts on dwellings.

Table 6-125: Overview of cumulative visual impacts on dwellilngs within 8 km of both the Uungula Wind Farm and the Project

Distance to nearest BWF WTG	Distance to nearest UWF WTG	No. of BWF WTGs visible	No. of UWF WTGs visible	Number of 60^o sectors with WTGs	Cumulative Visual Impact Rating
Dwelling ID: MLA-01					
7,241 m	**6,555 m**	**Approx 30**	**Nil**	**Two (2)**	**Nil**
The Uungula Wind Farm will be screened by topography from this dwelling, therefore there will be no opportunities to view both the Uungula Wind Farm and the Project simultaneously.					
Dwelling ID: MLA-03					
5,203 m	**791 m**	**2**	**Approx 50**	**Three (3)**	**Negligible**
The ZVI indicates views will be available to WTGs associated with both the Uungula Wind Farm and the Project. An assessment based on topography alone found approximately 50 WTGs associated with Uungula Wind Farm will be available to the north of the dwelling. Two (2) WTGs associated with the Project will be visible to the south east, however intervening vegetation is likely to screen views to the Project WTGs.					
Dwelling ID: MLA-05					
7,648 m	**4,500 m**	**Approx. 35**	**6**	**One (1)**	**Negligible**
The ZVI indicates views will be available to WTGs associated with the Uungula Wind Farm and the Project. An assessment based on topography alone found approximately 6 WTGs associated with Uungula Wind Farm will be available to the north of the dwelling. Approximately 35 WTGs associated with the Project have the potential to be visible to the south of the dwelling. One (1) WTG associated with the Project (WTG 96) is located within 8 km of the dwelling. Desktop assessment identified views to WTG 96 are screened by topography. Therefore, all visible WTGs associated with the Project are in excess of 8 km from the dwelling and the cumulative visual impact has been rated as negligible.					
Dwelling ID: ND-11					
6,404 m	**877 m**	**Nil**	**Approx. 70**	**Three (3)**	**Nil**
The Project will be screened by topography from this dwelling, there will be no opportunities to view the Uungula Wind Farm and the Project simultaneously.					
Dwelling ID: ND-17					
7,145 m	**1,616 m**	**Nil**	**Approx 70**	**Three (3)**	**Nil**
The Project will be screened by topography from this dwelling, there will be no opprotities to view the Uungula Wind Farm and the Project simultaneously.					

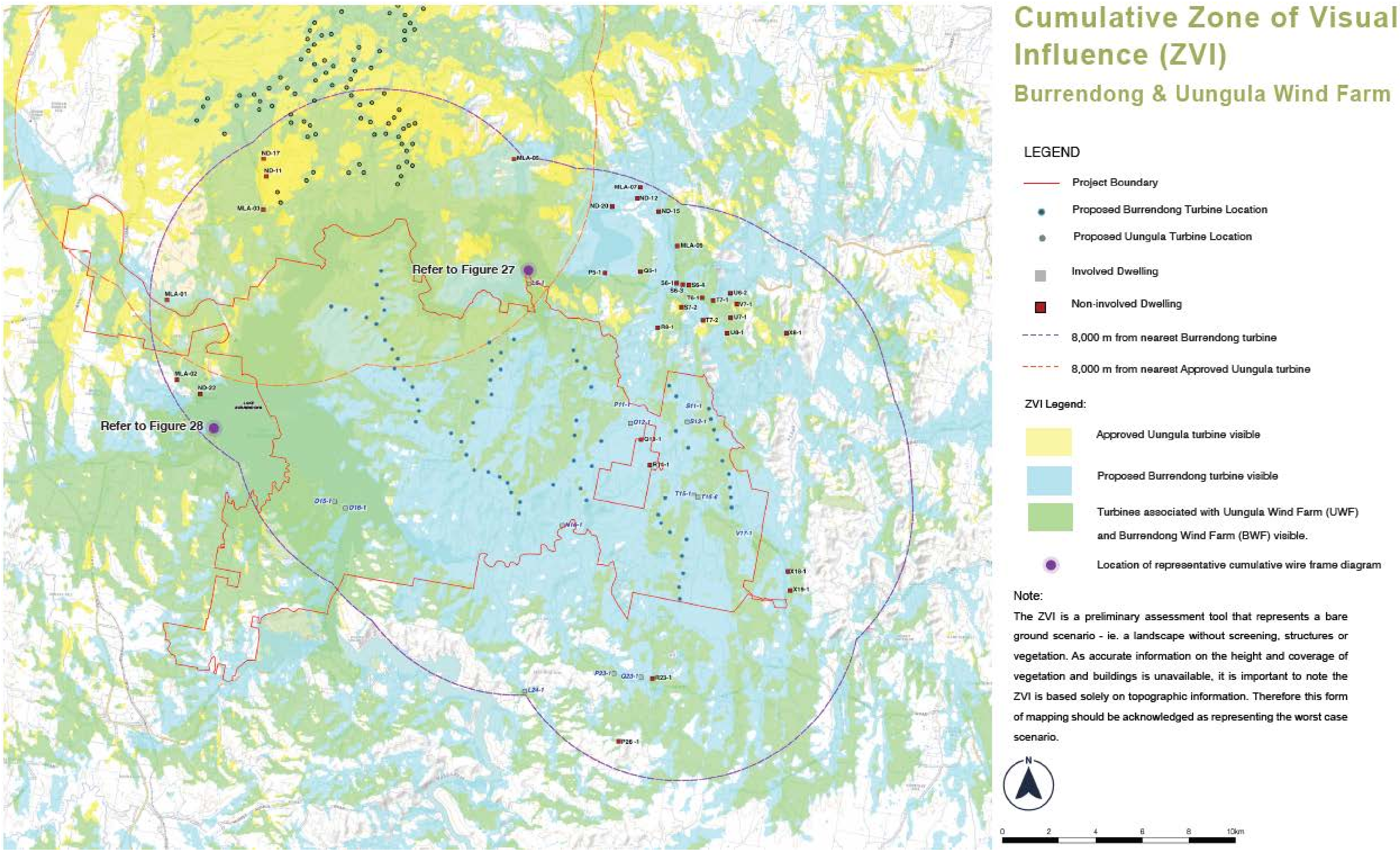


Figure 6-78: Cumulative ZVI for the Project and Uungula Wind Farm

PUBLIC VIEWING LOCATIONS

As the Project is proposed in a relatively isolated location and the landscape character is generally undulating, there are limited opportunities to view the Uungula Wind Farm and the Project simultaneously from publicly accessible locations. The cumulative assessment undertaken by MLA (2023; Appendix F) indicates that views to the Uungula Wind Farm and the Project would be available from Lake Burrendong and the Cudgegong River. Due to limited road access, views will be limited to people travelling by boat on the lake with the extent of visibility changing as they move through the landscape.

The LVIA (MLA, 2023; Appendix F) indicates some limited opportunities to view the Uungula Wind Farm and the Project from some locations within the Cudgegong River Park, however, the accommodation is generally orientated towards the north and as a result, views to the Project are likely to be limited.

There is potential to view the Uungula Wind Farm and the Project simultaneously from elevated viewing locations to the south west of the Project (Mount Aquila and Mookerawa). Views from elevated and cleared positions are limited and distant. It is noted that views from elevated locations on Mount Aquila Road of Uungula Wind Farm, through the Project, would be at a distance more than 25 km. As the Project Site is located within a largely isolated area of land, setback from major travel corridors, there is limited opportunities to view the Project sequentially along a travel route.

BROADER LANDSCAPE CHARACTER

The NSW Government has identified several key REZs in the State, including the Central-West Orana where the Project is located on the southern edge. The existing landscape character of the region allows for the optimum harvesting of wind energy due to the elevated topography, expanses of uninhabited land and minimal obstructions in the landscape.

The re-occurrence of wind farms within a region has the potential to alter the perception of the overall landscape character irrespective of being viewed in a single viewshed. As wind farm developments begin to proliferate, it is important to determine whether the effect of multiple wind farms and other major infrastructure within the region would combine to become the dominant visual element, altering the perception of the general landscape.

6.15.2.2. Noise and Vibration

The Project is proposed in an area with only one (1) other renewable energy project in proximity, being the Uungula Wind Farm. The majority the infrastructure proposed as part of the Project and the Uungula Wind Farm do not overlap in terms of noise contours across the landscape, given the relatively limited distance noise would propagate within the landscape. This will result in no cumulative noise impacts where noise contours from a single project apply. In accordance with the Noise Bulletin (DPE, 2016c), noise levels should not exceed 35 dB(A) at relevant receivers. As discussed in Section 6.4.2, receivers beyond 5 km are predicted to experience noise levels below 20 dB, significantly below the noise level of 35 dB.

The results of the NVIA (MDA, 2023; Appendix G) determined that cumulative noise considerations associated with the Project can be practically managed for receivers near to both the proposed Project and the approved Uungula Wind Farm. As shown in Figure 6-79, the overlapping noise contours of both the Project and the Uungula Wind Farm involving a receiver is within the 25 dB noise level, notably 10 dB below the base noise criterion applied to both projects. In particular, it was demonstrated that cumulative wind farm noise levels do not affect the compliance outcomes for either the Uungula Wind Farm or the Project.

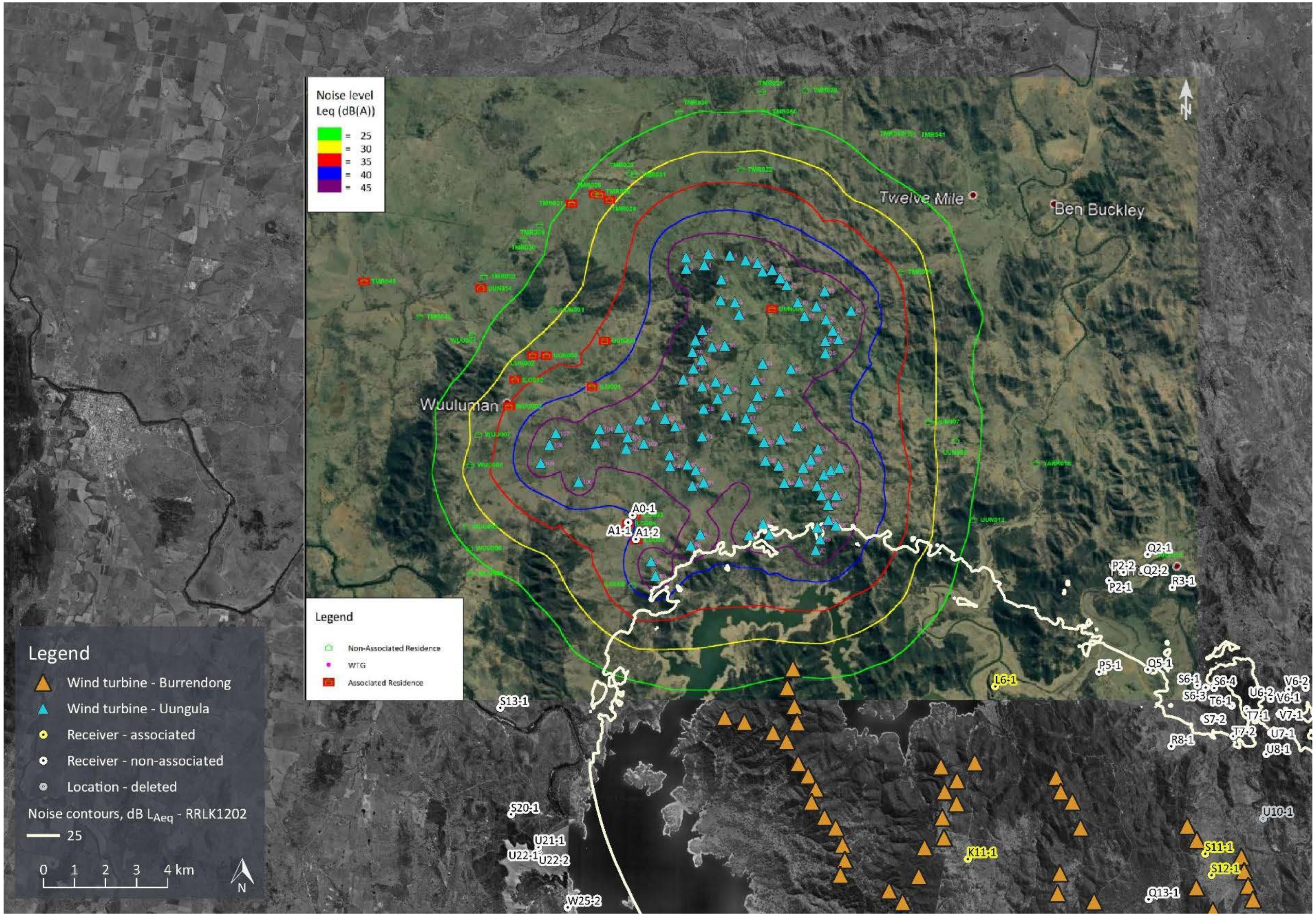


Figure 6-79: Predicted 25 dB LAeq noise contour map overlap from both Uungula Wind Farm and the Project (MDA, 2023)

6.15.2.3. Biodiversity

Cumulative impacts to matters of biodiversity can vary based upon the type of biodiversity value affected and the geographic spread of that species. Therefore, the BDAR (ELA, 2023a) determined that the Project is not likely to have cumulative impacts on most identified species within the Project Site as the Project is not co-located with any existing Wind Farm. However, the proximity of the Uungula Wind Farm and Bodangaro Wind Farm have the potential for cumulative strike impacts to occur. All three projects have or will implement a management plan that will be implemented during operation to avoid impacts to species flying through the landscape to assist in reducing potential cumulative impacts. Additionally, the permanent removal of vegetation to accommodate the development of the Project will only occur within the Development Corridor within the Project Site. Avoidance of high value habitat such as Box Gum Woodland, where possible, have limited the extent of cumulative impacts across the region. In this way, biodiversity impacts are localised and will not cross over with other proposed developments in the broader region. This includes all construction, operational and decommissioning works and as such will only have localised vegetation impacts.

Indirect impacts assessed during the BDAR (ELA, 2023a) such as lighting and noise during construction were determined to not reduce the viability of adjacent habitats to the Project Site due to the distance between developments. Given the only project within proximity to the Project Site being the Uungula Wind Farm, light and noise impacts on adjacent habitat viability are unlikely as neither impact type would result from multiple projects on specific areas of adjacent habitat. Similarly, instances of starvation, exposure and loss of shade or shelter are not anticipated to be affected by cumulative impacts given the location of the Development Corridor within the broader Project Site, availability of adjacent habitat, the considerable distance between proposed projects and the localised nature of vegetation impacts.

Indirect impacts due to blade strike have the potential to add to cumulative impacts for species such as the *Miniopterus schreibersii* (Eastern Bent-wing Bat), due to the loss of individuals in the general region. Due to the distance between these wind farms, this cumulative impact is suspected to be minimal. It is noted however in the BDAR (ELA, 2023a) that while no known cliffs, caves or potential breeding habitat occurs within the Project Site, populations recorded within the Project Site are known to have travelled from the Burran Burran Caves. These caves are approximately 50 km northwest of the Project Site and the flight paths are likely to traverse the Uungula Wind Farm, increasing the potential for cumulative strike risks. This is based on the location of both the Burran Burran Caves and threatened cave dwelling bat recordings recorded within the Project Site, putting Uungula wind farm between the two locations.

6.15.2.4. Traffic and Transport

There are several renewable energy projects in the region, from planning stages through to construction, that are likely to utilise some of the same major roads as the Project for OSOM movements. These projects include:

- Central West Orana Transmission Link (proposed)
- Uungula Wind Farm (Approved)
- Barney Reef Wind Farm (In Planning)
- Spicers Creek Wind Farm (In Planning)
- Bellambi Heights Solar Farm (In Planning)

- Burrundulla Solar Farm (In Planning)
- Geurie Solar Farm (Approved)
- Maryvale Solar Farm (Approved)
- Sheraton Road Solar Farm (Approved)
- Tallawang Solar Farm (In Planning)
- Wellington Road Solar Farm (Approved).

The locations of these major development sites are shown in Figure 2-5.

All of the identified projects except for Uungula Wind Farm and the proposed Central West Orana Transmission Link are located more than 10 km from the Project Site and are unlikely to utilise the same local roads. The majority of the projects are solar farms with the longest OSOM vehicle required to transport solar farm components being considerably shorter than OSOM vehicles transporting a WTG blade. This means that solar farm OSOM vehicles may find it easier and quicker to reach their destination in comparison to wind farm OSOM vehicles.

Furthermore, the midblock road capacities have been assessed with due regard to other projects / developments in the region. Although unlikely, it has been assumed that the Project will have overlapping construction periods with Uungula Wind Farm and Maryvale Solar Farm. During peak hours of the peak construction months, Project-related traffic is estimated to only have a minor impact, increasing cumulative traffic volumes on Goolma Road from 256 veh/h to 305 veh/h, and from 345 veh/h to 376 veh/h on Mitchell Highway. Both roads would still operate satisfactorily within their road capacities.

The main potential cumulative traffic impacts will be the scheduling of OSOM movements on the same OSOM routes outlined in Section 6.15.2.4. The OSOM routes may experience cumulative impacts along major roadways such as the Golden Highway and Mitchell Highway, though this will not impact road users on local roads in proximity to the Project. Additionally, the various stages of planning for the projects listed above means that the potential for numerous projects requiring OSOM vehicles during the same construction period is highly unlikely. The coordination of OSOM deliveries can be addressed as part of each representative projects Traffic Management Plan post-approval.

The only other major development, being Uungula Wind Farm, proposed in the vicinity of the Project Site is likely to have commenced construction before the Project and will have limited to no cumulative traffic impacts.

6.15.2.5. Hazards and Risks

AVIATION

The Project is anticipated to avoid impacts to any OLS, PANS OPS, LSALT, ATC surveillance systems, existing air routes or contingency procedures. The Aeronautical Impact Assessment (Landrum & Brown, 2022) did not determine any cumulative impacts involving the Project, besides potential long term cumulative effect as a result of cumulative obstacle lighting. They note that it is unlikely to be a decision making issue as design and mitigation measures may ameliorate some consequences. The development of other wind farms in the area may result in impacts to the LSALT protection surfaces, requiring alterations to air routes. This is due to the nature of WTGs in the environment and their placement often on elevated ridgelines and hills. It is hard to predict if this is likely to occur or when, and as such no cumulative impacts are anticipated.

BUSHFIRE

The defined study area for cumulative impacts in relation to bushfire threats has been considered to be 5 km. The only other development that falls within the defined Study Area is the Uungula Wind Farm approximately 4 km to the north of the Project Site. Given the overlapping nature of some Project elements, there is potential for bushfire impacts to both developments to occur.

TELECOMMUNICATIONS

Telecommunication impacts from wind farms are typically related to the direct impact and/or infringement on telecommunication links. The Project is able to significantly limit its impact on telecommunication links as there are no ACMA communication sites located within 2 km of the Project Site.

From a point-to-point perspective, issues typically occur when there is an interruption between points and given the significant distance between the Project Site and other major projects, it is unlikely for cumulative point-to-point impacts to occur. The same principle applies to AM/FM/DTV and mobile phone reception which is unlikely to be impacted given the scale of separation between projects.

Where cumulative impacts may occur is on weather radar in the region. This could occur when multiple WTGs are located within the Radar Line of Site (RLoS) and impact on the radars ability to determine weather related information. It is unclear at this stage whether any cumulative impacts would occur but is considered unlikely.

BLADE THROW AND SHADOW FLICKER

The impacts of potential blade throw and shadow flicker events on receivers are highly localised occurrences. As discussed in Section 6.7.2.6, the occurrence of blade throw events has been observed to occur within 1.5 km of a WTG base. Therefore, even the project elements in closest proximity to the Uungula Wind Farm are sufficiently separated so that cumulative blade throw events is not considered feasible. Similarly, shadow flicker occurs when a shadow is cast onto the landscape by a WTG. The impacts of shadow flicker occur locally with WTGs not being able to cast a shadow a long enough distance to result in overlapping events by both projects. Therefore, no cumulative impacts relating to blade throw or shadow flicker are anticipated because of the Project and the Uungula Wind Farm.

6.15.2.6. Aboriginal Heritage

The Project Site, as with the broader area surrounding the Project Site, is located on the traditional lands of the Wiradjuri People who have a continued connection to the land. The proposed location of the WTGs will be on the ridges and spur crests which are typically highly exposed. The ACHA undertaken by ELA assessed the potential impacts of the Project on matters of Aboriginal heritage that may be located within the Project Area.

The ACHA for the Project and other renewable energy projects in the region focus on determining the presence of Aboriginal locales and artefacts within the prescribed study area. This is due to the nature of the proposed projects often located on elevated ridgelines and hills that were typically less frequented. Given the localised scale of impacts to locales and artefacts, cumulative impacts are considered unlikely to occur to singular elements. However, it is acknowledged that the development of more projects within the region will collectively result in more impacts. The implementation of robust mitigation and consultation measures put in place to reduce harm to matters of Aboriginal heritage is essential in reducing the collective impacts to matters of Cultural heritage and importance. The Project will implement a number of mitigation measures to manage impacts within the Project Site and consider the location of items of cultural heritage in the detailed design phase to limit the cumulative impact potentially felt by Wiradjuri people as an increase in projects within the Wiradjuri nation is likely to result in an increase in impacts.

6.15.2.7. Historic Heritage

The Project Site is proposed in a rural setting and features no Commonwealth, State, or Locally listed heritage items. While two (2) locally listed heritage items are located adjacent to the Project Site, no works are proposed in proximity to them and therefore they will not be impacted. Given the location of the locally listed heritage items and the Uungula Wind Farm, the significant distance between them will present no potential for cumulative impacts such as viewing multiple projects in relation to the heritage items. The varying topographic nature of the area, limited number of heritage items and sites, and significant distances between renewable energy projects means no cumulative impacts are anticipated.

6.15.2.8. Agricultural Land, Soils and Land Use

Major projects are at different stages of the planning and delivery process as identified below. As the overall impact of the project on agricultural land is minimal (<0.01% of regional production), it is not expected to make a significant contribution to agricultural cumulative impacts from infrastructure projects. Cumulative impacts to soils and agricultural lands are not anticipated because of the Project given the limited land impacts and location of WTGs and ancillary infrastructure. There is the potential for soil contamination from individual projects reaching tributaries and eventually ending up in watercourses which may have a compounding effect. The development of the Project, and similar renewable energy projects in the region, do require the transition of typically agricultural land to facilitate the placement of WTGs and associated infrastructure. However, the land use change required is limited cumulatively in relation to the overall land used for agricultural purposes within the region and is often located on land with limited agricultural capability, often seeking to avoid land with valuable land use capabilities.

6.15.2.9. Surface Water, Ground Water and Aquatic Ecosystems

The Project is proposed in an area that will allow it to utilise the elevated ridgelines and hilltops and is not anticipated to result in cumulative impacts on surface water, groundwater or flooding. This is a result of limited projects in proximity to the Project Site and limited anticipated impacts on groundwater supply and existing watercourses. Given the positioning of WTGs and ancillary infrastructure on predominantly elevated areas within the Project Site, impacts to flooding regimes are not anticipated either.

During the construction phase, large quantities of water will be required mainly for the production of concrete for the WTG hardstands and ancillary infrastructure foundations. This will likely require the transportation of water sourced locally, where possible, to the Project Site. There is the potential for some overlapping water requirements to occur with the Uungula Wind Farm to the north of the Project Site, however this will be determined by the construction phases of each project and will be considered in the detailed design phase and in consultation with water suppliers.

There is the potential for contamination as a result of soils being washed into surface water flows during periods of rain, primarily during construction. Though this is not anticipated given the proposed location of WTGs and ancillary infrastructure along elevated ridgelines and rocky outcrops and the implementation of appropriate measures such as bunding and swales to limit the movement of soils into waterways. The likelihood of impacts is further reduced given the largely degraded nature of riparian corridors within the Project Site, and the detailed mitigation measures to reduce potential impacts on water soils and construction waste.

6.15.2.10. Resource Requirements and Waste

The Project is proposed in proximity to the Uungula Wind Farm which will likely utilise similar resource and waste facilities. However, as the Uungula Wind Farm has already received development approval, the construction timelines for the two projects are unlikely to overlap. Additionally, the Uungula Wind Farm identified the Wellington Waste Transfer Station and the Whylandra Waste and Recycling Centre as the most appropriate waste facilities, while the Project identified the Mudgee Waste Facility as the most appropriate. This will help mitigate potential cumulative waste impacts on local resource and waste facilities should construction periods overlap by diverting waste from the two projects to different waste facilities. It is noted that given the rural setting and limited access to facilities to service multiple projects, there is the potential for cumulative impacts to occur as a result of overlapping supply and/or waste requirements and a cumulative increase in the total volume of waste received by waste facilities. Such impacts are assumed to be appropriately managed through the preparation and implementation of a Waste Management Plan by each project.

6.15.2.11. Social and Economic

The cumulative impacts on social and economic aspects of the wider community are more multifaceted with impacts having potentially both positive and negative implications. The clear economic impact of numerous projects within the REZ is the anticipated enormous expenditure in local and regional communities and the flow on benefits associated with multiple multi-million dollar infrastructure developments. These benefits will see numerous financial benefits to landholders, councils and communities where various levels of investment in communities is made by proponents, such as community funding grants and sponsorships. This is referenced in the SIA (Ethos, 2023a) where the presence of an expected peak construction force of 8,000 workers by 2025 is anticipated to inject a significant amount of economic stimulus into small and regional communities but some landholders and councils feel the increase will “change the feel of the towns and some venues… where locals no longer want to frequent”.

The Economic Impact Assessment (Ethos, 2023b) conducted a cumulative impact assessment with regard to other renewable energy projects within the Dubbo and Mid-Western LGAs. It found that where impacts were high, they were associated with a potential construction overlap that would likely result in increased competition for labour and accommodation. With the increase in job opportunities and workers spending their income into local economies comes an increase pressure on local housing required to house workers over the course of the construction periods. Further positive cumulative impacts are likely upgrades to a number of local roads in order to facilitate the projects, increasing the safety and useability of roads for local users as well. The economic cumulative effects assessment undertaken by Ethos (2023b) is shown in Table 6-126.

Other impacts of multiple renewable energy projects within the REZ can be considered on specific grounds, whereas the social and economic implications of numerous projects in a given geographic area are harder to define and will likely provide numerous benefits and limitations to a range of stakeholders. It is vitally important to increase the renewable energy generation capacity in NSW and Australia but it is also essential to do so in a way that considers the impacts on the everyday lives of people living in communities where projects are proposed. The SIA and EIA by Ethos Urban found a number of factors indicate potential for negative impacts if appropriate management and planning initiatives are not put in place, particularly in relation to the Project's labour and accommodation needs. Detailed mitigation measures have been provided in Appendix E and the potential labour and procurement requirements of multiple concurrent renewable energy projects has the potential to underpin the development of a deep renewable energy skills base that may result in efficiencies and further economic opportunities for the region.

With regard to the proposed renewable projects discussed below, the following has been noted by Ethos Urban:

- The development status of projects varies. Some projects are approved but construction has yet to start, and other projects are currently going through the planning process. Therefore, the construction timing is uncertain and not all projects may end up proceeding.
- New developments (not yet proposed or planned) may emerge in the period prior to construction of the Project especially as the CWO REZ matures.

The above factors indicate potential negative impacts if appropriate management and planning initiatives are not put in place, particularly in relation to the Project's labour and accommodation needs. However, the labour and procurement requirements of multiple concurrent renewable energy projects in the Study Area have potential to underpin the development of a deep renewable energy skills base that may result in efficiencies and further economic opportunities for the region.

Table 6-126: Planned and approved renewable energy and other major projects in the study area (Ethos, 2023b)

Project	Status	Construction Period	Impact Rating
Uungula Wind Farm	Approved	Currently at contracting and financing stage. Contractor yet to be procured. Estimate mid-late 2024 to commence. Construction period 24 – 30 months	**Low** Project likely to be completed / largely completed by the time the BWF project commences.
Maryvale Solar Farm	Approved	Construction to commence in late 2023 and commercial operations projected to commence in 2025.	
Wellington North Solar Farm	Under Construction	Now	
Stubbo Solar Farm	Approved	Construction of the site access has commenced, construction of main project works expected to commence in 2023, assume for 24 – 30 months	
Geurie Solar Farm	Approved	Unknown	

Forest Glen Solar Farm	Approved	Approved Feb 2023. Assume commence construction in 12 or so months (mid 2024) for 24 – 30 months	
Sheraton Road Solar Farm	Approved	Unknown	
Burrundulla Solar Farm	In Planning	Unknown	**Medium** Potentially competing for labour and accommodation given the large scale of this project and its relative proximity to the BWF Project Site.
Tallawang Solar Farm	In Planning	At Response to Submissions stage. Assume approval by the end of 2023 and construction to commence in 2025 for 24 – 30 months.	
Bellambi Heights BESS	In Planning	SEARs expire 26/4/2025. Assume construction 3 years from EIS submission approx. end of April 2028 for 24 – 30 months	
Birriwa Solar Farm	In Planning	At Response to Submissions stage. Assume approval by the end of 2023 and construction to commence in 2025 for 24 – 30 months.	
Spicers Creek Wind Farm	In Planning	SEARs expire 6/5/2024. Assume construction 3 years from EIS submission approx. mid-May 2027 for 24 – 30 months	**High** Construction phase overlap is likely resulting in competition for labour and accommodation
Barney Reef Wind Farm	In Planning	SEARs expire 14/9/2023. Assume construction 3 years from EIS submission approx. mid-September 2026 for 24 – 30 months	
Sandy Creek Solar Farm	In Planning	SEARs expire 25/5/2024. Assume construction 3 years from EIS submission approx. end of May 2027 for 24 – 30 months	
Ulan Solar Farm	In Planning	SEARs expire 21/9/2024. Assume construction 3 years from EIS submission approx. end of September 2027 for 24 – 30 months	
Central-West Orana Transmission Project	In Planning	Construction expected to commence in the second half of 2024 and ongoing for three years.	

6.15.3. Mitigation Measures

Table 6-127: Mitigation Measures for Cumulative Impacts

Environmental Impact	Mitigation Measure	Reference Code
Visual	Consider the viewing shed principle of other projects in relation to involved and non-involved landowners when developing mitigation measures such as screening at dwellings.	CM001
Traffic and Transport	Consultation with TfNSW to consider potential cumulative traffic impacts because of multiple developments requiring the transportation of resources along major roadways.	CM002
	Consultation with waste facilities to schedule appropriate OSOM and heavy vehicle movements and reduce road pressures and delays on local roadways to and from the facilities.	CM003
Telecommunications (Weather Radar)	Where possible, locate WTGs outside of the weather Radar Line of Site (RLoS) to minimise wind farm interference.	CM004
Socio-economic	Consultation with Council and local service providers to facilitate early responses to accommodation and township infrastructure to attempt to pre-empt workforce influx from multiple projects occurring.	CM005

6.16. Residual Environmental Risk Assessment

A residual environmental risk analysis has been undertaken for all potential environmental impacts that have been considered within the EIS and considers the mitigation measures outlined in Appendix E. The analysis uses the risk matrix provided in Table 6-1. The results of this residual risk analysis are provided in Table 6-128.

Table 6-128: Residual Environmental Risk Assessment for each environmental factor assessed

Factor	Receptor(s)	Potential Impact	Likelihood	Consequence	Mitigated Risk
Landscape and Visual	Nearby residences	Reduction in visual amenity	4	A	Medium
	Adjoining landscape	Reduction in visual amenity	4	A	Medium
Noise and Vibration	Nearby residences	Nuisance noise levels during construction	3	A	Low
		Nuisance noise levels during operation	3	A	Low
Biodiversity	Flora species, plant communities and/or habitat	Disturbance/loss	5	A	Medium
	Fauna species	Injury and mortality	2	B	Low
	Terrestrial and aquatic ecosystems	Introduction/spread of weeds	2	A	Low
		Introduction/spread of pests	2	A	Low
		Sedimentation and erosion	2	A	Low
		Soil and water pollution	2	A	Low
		Indirect impacts of proposal e.g. light, noise, dust	2	A	Low
Traffic and Transport	Existing road network	Increase in traffic volumes	3	A	Low
		Increased traffic risks and/or reduced safety	2	B	Low
Hazards / Risk	Aviation activities	Aviation safety	2	B	Low
	Telecommunications distributors	Effects on telecommunications systems	2	B	Low
	Project Site and nearby residences	Health issues relating to electromagnetic fields	2	A	Low
		Health issues relating to low frequency noise and infrasound	2	A	Low
		Health issues relating to shadow flicker and blade glint	2	A	Low
		Bushfire and electrical fire	2	D	Medium
		Blade throw	1	D	Medium
Heritage	Aboriginal heritage	Impacts on known artefacts/values	2	A	Low
		Impacts on unknown artefacts/values	2	A	Low

Factor	Receptor(s)	Potential Impact	Likelihood	Consequence	Mitigated Risk
	Historic heritage	Impacts on known artefacts/values	2	A	Low
		Impacts on unknown artefacts/values	2	A	Low
Water and Soils	Surface water	Degradation of water quality	1	A	Low
	Project Site	Disturbance and erosion of soils and productive topsoil	2	A	Low
		Soil compaction leading to concentrated runoff and erosion	2	A	Low
		Soil contamination due to spills	2	A	Low
		Introduction/spread of weeds	2	A	Low
	Nearby properties	Reduced agricultural viability	2	A	Low
		Dust deposition	2	A	Low
		Reduction in water quantity	1	A	Low
		Flooding	1	A	Low
	Groundwater	Degradation of water quality	1	A	Low
		Reduction in water quantity	1	A	Low
	Aquatic Ecosystems	Direct Impacts	2	A	Low
		Indirect Impacts	2	A	Low
Waste	Project Site and adjoining areas	Contamination of land and water	1	A	Low
		Resource wastage	2	A	Low
		Human and environmental health	2	A	Low
Social and Economic	Social	Safety	2	B	Low
		Health	2	A	Low
		Water Consumption	3	A	Low
	Economic	Decreased Land Value	1	A	Low

CHAPTER 7

Project Justification

7.1. Project Design

Developing a socially and environmentally responsible renewable energy project requires the Proponent to continuously consider factors that may impact the final design. Over the course of the Project design process, the Proponent has sought to incorporate these factors into the overall Project proposed. Several factors were involved when considering the preferred layout during the 'site selection' phase, as discussed in Section 2.5. These considerations included assessing wind resources, ease of connection, site access, proximity to residential properties, the presence of significant environmental constraints and interest/dialogue within the local community. The location of the Project Site was selected because of its suitability regarding wind resources and limited environmental and social constraints identified during the scoping phase.

Following the site selection for the Project, several assessments have been conducted to further understand the potential impacts and benefits the Project may have within the landscape and broader communities. As discussed in Section 2.5 and outlined in Figure 2-15, the Project has undergone several design changes following the results of technical assessments and stakeholder engagement. The willingness of the Proponent to adjust Project elements is best demonstrated in the changes to the number of proposed WTGs to minimise impacts on biodiversity values, heritage values and visual receivers. Multiple changes to the number of WTGs have occurred throughout the development process, with the proposed 70 WTGs having been reduced from a total of 105. This was largely due to changes in landowner consent and in response to environmental assessments (including noise and visual impact assessments). The reduction in the number of WTGs from 105 to 70 WTGs has also seen a reduction in the total size of the Development Footprint, with the Development Footprint proposed on 1,042.86 ha and will now involve 781 ha of land, a 25% decrease. This footprint is inclusive of the Wind Farm, the Southern Transmission line option and the Yarrabin Road Upgrade.

The proposed Project Site presents an opportunity to develop a wind farm that can provide numerous benefits with relatively limited environmental and social impacts. However, several environmental constraints have been identified within the Project Site as identified in Section 3.1.3. Wherever possible, the Proponent has sought to amend the Project design to avoid identified environmental constraints. The sections below summarise how the design hierarchy principle of avoid, minimise, mitigate, and offset, were adopted.

7.1.1. Landscape and Visual

It is inevitable that the placement of WTGs in a rural landscape will alter the existing landscape character of the area to some degree (MLA, 2023; Appendix F). The Project can be considered in contrast to the rural, pastoral lands and large expanses of vegetation that characterises the existing landscape.

The objective of the LVIA (MLA, 2023; Appendix F) is to determine how the Project will impact the existing visual amenity, landscape character and scenic quality. The overall visual impact of the Project will vary greatly depending on the individual viewer's sensitivity to and acceptance of change. For example, visitors to the area may perceive the Project as an interesting feature of the landscape whereas a resident who passes the Project daily may have a more critical perception of the visual presence of the Project. The visual impacts of the Project are also dependant on the distance of the vantage point to the Project. As MLA (2023; Appendix F) points out, the impact of WTGs is lessened as the distance of the vantage point is lengthened, as well as the implementation of various screening tools to obscure the potential view of a WTG at a given location.

The topography surrounding the WTGs significantly alters the visibility of the Project from many vantage points. Within the local setting, a combination of the topography and local influences such as existing natural and introduced vegetation significantly reduce visibility towards the proposed WTG locations. The greatest visual effect is most likely to be felt by residents in the immediate vicinity of the Project, namely for two (2) non-involved dwellings that were determined to have a potentially high visual impact. However, as there are twenty (20) non-involved dwellings within 4,950 m of a WTG, the limited number of potentially highly impacted dwellings demonstrates the importance of designing the Project in a way that minimises potential impacts to receivers. Mitigation methods incorporated into the design process in conjunction with landscape and visual screening will have a positive effect on reducing any visual impact of Project. At a first instance, the Visual Bulletin (DPE, 2016b) was utilised to aid in developing the preliminary Project layout.

When implemented with appropriate environmental management, the development of wind farms can be undertaken with low impact on the surrounding environment whilst providing positive local, regional, and national benefits. It is the professional opinion of MLA that the social, environmental, and economic benefits of the Project far outweigh the identified visual impacts associated with the Project.

7.1.2. Noise and Vibration

A cursory review of the Global Wind Atlas highlights the significant wind resources across Australia, typically located in rural settings that are often characterised by low background noise levels. The Project aims to take advantage of the abundant wind resources available to design a wind farm that produces the maximum number of emissions free energy as possible, while minimising the auditory impacts of the development on the surrounding environment. Given the rural setting the Project Site is proposed, the development will introduce limited additional noise that is not otherwise typically found. However, the additional noise is assessed as being within the thresholds outlined in the Noise Bulletin (DPE, 2016c) and largely experienced by stakeholders near the Project infrastructure, such as involved landowners.

The objective of the NVIA (MDA, 2023; Appendix G) is to assess the likely impacts of the Project on the surrounding environment as well as involved and non-involved receivers. The overall impact of the Project will vary between receivers depending on their proximity and involvement with the Project. As such, involved receivers will experience higher levels of noise output from the Project compared with non-involved receivers. The results of the noise modelling for the Project demonstrate that the predicted noise levels for the proposed layout will operate below the minimum noise limit outlined in the bulletin at all but one (1) non-involved receiver, being 35 dB. The WTG noise levels are predicted to be above the applicable noise limit by up to 1.0 dB though detailed mitigation measures have been designed to address this.

The impact of noise on a receiver is reduced the further away a receiver is from the source of noise, with the Project design seeking to place WTGs in a layout that minimises the number of receivers located within certain noise thresholds. The NVIA (MDA, 2023; Appendix G) assessed the noise impacts of a candidate model to determine the impacts of each within the landscape. This is done to represent the likely WTG model to be selected following a range of design requirements in the detailed design phase.

Ultimately, the receivers within the immediate vicinity of the Project will most likely experience the greatest impacts from the Project. To reduce further the impacts of noise, mitigation measures incorporated into the design process and will positively impact the effects of noise from the Project. From the beginning of the design process, the Noise Bulletin (DPE, 2016c) was utilised to ensure the development of a project that appropriately considers noise impacts and actively seeks to avoid them wherever possible.

With appropriate implementation of environmental management and consideration for the impacts of noise within the landscape, the development of the Project can be undertaken with limited impacts on receivers while generating key benefits locally, regionally, and nationally.

7.1.3. Biodiversity

The Project Site borders Lake Burrendong and consists of predominately previously cleared pastoral and agricultural land but also contains native vegetation and TECs. Additionally, several threatened species were identified within the Project Site during field survey. These includes three (3) species of threatened bats, four (4) species of birds (including 1 migratory bird) and one (1) mammal. It is noted however that following extensive inspection, no specialized breeding/roosting/refuge habitat were present indicating the species were not located within the Project Site. As such, no species credits for threatened bats would be generated.

Even prior to the inspections by ecologists, the location of infrastructure across the Project Site was proposed on land previously modified by agricultural development as much as possible. A preliminary vegetation survey of the Project Site was undertaken by ELA in 2019 to identify potential biodiversity constraints as well as undertake observations to identify the extent and type of native vegetation and possible PCTs present. The information was used to further refine the Project Site to avoid and minimise impacts to biodiversity values within the Project Site. The majority of the Project Site is located on land that is currently, and historically, used for grazing and agriculture. In these areas the native understorey and midstorey are diminished and often contain significant amounts of non-native vegetation.

The Development Footprint has located a large proportion of infrastructure on land with the lowest biodiversity value (such as exotic vegetation or disturbed areas). Large patches of more intact vegetation have been avoided where possible, resulting in 84% of the Development Footprint consisting of non-native vegetation. No threatened flora was recorded within the Project Site meaning that the Project is unlikely to impact a threatened flora species because of development. It is noted that records of *Acacia ausfeldii* (Ausfelds wattle), *Dichanthium setosum* (Blue grass), *Eucalyptus cannonii* (Capertee Stringybark), *Swainsona recta* (Small Purple Pea) and *Swainsona sericea* (Silky Swainson-pea) occur within 10 km of the Project Site with most records occurring near the eastern route road upgrade. For this reason, that area has now been excluded from the Project Site, further reducing the change of impacts to biodiversity values.

Areas of the Critically Endangered Box Gum Woodland and intact vegetation have been avoided where possible. The majority of the associated Box Gum Woodland PCT's do not meet the condition threshold for the EPBC Act listed CEEC White Box Yellow Box Blakely's Red Gum Woodland and Derived Native Grassland due to the degraded understory not containing sufficient cover or diversity of native species. Further efforts have been undertaken to reduce the impacts of the Project on areas of native vegetation including the reduction of the clearing footprint, locating ancillary facilities in areas with no biodiversity values and providing structures to enable species and genetic material to move across barriers or hostile gaps, among other efforts.

Mitigation measures for biodiversity are detailed in Table 6-44 and will include the preparation of a BMP and BBAMP. Although all efforts to avoid and minimise impacts to biodiversity have been sought as a first instance, the Project will still require both ecosystem and species credits to mitigate impacts to biodiversity. Based on the current Development Footprint, the proponent will be required to retire 17,771 ecosystem credits for impacts to native vegetation and 27,662 species credits for impacts to threatened species and their habitat if the Southern Transmission Line option is chosen. If instead the Northern Transmission Line option is chosen, 17,568 ecosystem credits and 31,928 species credits would need to be retired. There are three options in which the Proponent can retire the required credits:

- Establishing conservation agreements called Biodiversity Stewardship Agreements (BSAs) on land which generates the matching credits.
- Or by purchase of the appropriate credits from a vendor (who has established a BSA on their own land).
- Or by payment to the Biodiversity Conservation Fund (BCF) at the price provided in the Biodiversity Offsets Payment Calculator (BOPC).

7.1.4. Traffic and Transport

The construction of a wind farm at the scale of the Project will require the movement of an increased number of material and personnel on local roadways which will undoubtably impact their existing capacity. The Project will see an uptake in traffic users, primarily during the construction phase which will see an increase in large vehicles specifically, and traffic more generally.

The objective of the Traffic and Transport Impact Assessment (Stantec, 2023; Appendix J) is to assess the impact of the increase in vehicles along the proposed roads on other road users and stakeholders along the proposed routes. The impacts of traffic will vary greatly among stakeholders due in large part to the spatial and temporal nature of traffic to be generated as part of the Project, with road users on larger state and regional roadways experiencing limited changes compared to road users on local roads and residents along the proposed routes. This is directly related to the capacity of existing roads to accommodate an increase in vehicle movements.

The potential impacts of traffic generated from the Project are lessened as the vast majority of total traffic generated during the construction phase is expected to be light vehicles which will have the least impact based on vehicle type.

While there will be an increase in traffic during the construction period, it will also see an increase in construction jobs, providing employment opportunities for local communities and economic stimulus from wage expenditure in local communities where most of the employment, and employee transport is expected. The traffic impacts associated with the Project are unavoidable but are limited to the specific transport routes proposed to be utilised to and from the Project Site and are expected to last for 24-30 months. The traffic component of the Project has considered impacts to road users and local community members along the proposed transport routes and will make every effort to reduce impacts wherever possible. While the construction period will be approximately 24-30 months, OSOM vehicles will only be required during months 15 – 21 and will make deliveries at night to minimise impacts to the road network. The proportion of OSOM vehicles used by the Project will make up only 2% of total vehicle movements. Furthermore, even during the peak construction period of months 9-10 where vehicle movements will be its highest, all roads considered along the route to the Project Site has been assessed to maintain its current Level of Service, indicating that the roads have capacity to cater to the highest traffic flows generated by the Project. Though members of the local community may be impacted by increased traffic, mainly over the course of construction, and upon completion, the Project will also deliver mutually agreed opportunities for landowners, neighbours, and the wider community. Mitigation measures incorporated into designing the Project will have a positive effect on reducing the impacts on traffic and transport, particularly within a local context.

The development of the Project will temporarily impact road users and local stakeholders, though the scale of impact will be limited through effective planning and mitigation. As opposed to other, more permanent changes because of the Project, the traffic impacts are largely limited to the construction period of the development.

7.1.5. Hazards and Risks

The development of WTGs in a rural setting poses certain risks and challenges including:

- Fire risk to and from the Project, including bushfires and electrical fires.
- Aviation risk due to the placement of WTGs on elevated ridges.
- Telecommunication risks to various forms of communication links in the locality.
- Shadow flicker on people within or travelling through the landscape.
- The potential of blade throw to nearby dwellings and infrastructure.

Numerous assessments were conducted to determine the potential impacts of these risks and provide comprehensive measures for how the Project can limit them. The impacts of these risks will depend on numerous factors, both within and outside of the Proponent's control. The consideration of these risks resulted in the development of various mitigation measures into the design process to help reduce the likelihood of occurrence as outlined in Table 6-60.

This includes the placement of all WTGs outside of the OLS of any nearby aerodrome as well as well below all registered flight paths in the vicinity of the Project Site. Therefore, the Project is expected to not present any risk to ongoing aerial operations in the area. The Telecommunications Impact Assessment (Middleton, 2023; Appendix L) further aided the design of the Project by outlining potential telecommunication links within the Project Site and allowing for WTG siting to consider their impacts on the telecommunications infrastructure within the Project Site. Middleton Group (2023) determined that one (1) ACMA link falls within the Project Site and therefore a detailed assessment of near-field effects was undertaken to determine potential impacts. The assessment found that while one (1) link is located within the Project Site, the detailed assessment of near field effects, reflection and scattering effects, and diffraction found that the link does not pass within 2 km of a WTG which would potentially impact telecommunication links.

The design of wind farms is often co-located in rural areas with vegetation types that can provide fuel for bushfires. It is therefore vital to consider the fire climate, fire history and fuel hazards associated with a proposed wind farm. The Project undertook a detailed Bushfire Risk Assessment (ELA, 2023b) to provide a clearer picture of the fire danger to and from the Project in terms of bushfire. This assessment determined that a bushfire impacting the Project Site is considered very low and provided multiple measures to further reduce the potential impact of a bushfire occurring. These include the requirement for APZs in line with the BPB to act as fire breaks between any infrastructure and a fire, appropriate construction methodologies such as avoiding construction during periods of bushfire danger and the provision of vegetation management on site to reduce any build-up of fuel hazards.

The Project design process factors in numerous elements that could pose potential impacts to involved and non-involved receivers, including the potential for blade throw to occur. The Proponent has sought to employ WTGs with automatic shutdown governors to shutdown WTGs in the event of wind speeds exceeding safe limits. In conjunction with deploying technology designed to minimise the potential for turbine failure, the location of proposed WTGs further reduces the risk of impacts to stakeholders or property in the event of blade throw.

However, in the event of blade throw occurring, which studies have indicated has a likelihood of between 0.001% - 0.0001%, further design measures need to be considered to reduce the potential for turbines or fragments to pose a risk to involved and non-involved receivers. Based on studies that suggest the maximum blade throw distances fall between 200 m to 1,500 m, with the majority falling within 500 m for blade fragments. Taking into account the risk of blade throw and the recommended buffers around WTGs, the Proponent has designed a Project layout with only two (2) involved receivers and no non-involved receivers located within 1,500 m from a WTG, with the statistical change of a blade and/or fragment impacting on an occupied residence being an extremely low 0.0008%.

7.1.6. Aboriginal Cultural Heritage

The area surrounding Lake Burrendong is located on the traditional lands of the Wiradjuri people. The Proponent recognises the importance of developing the Project in a way that is respectful of the traditional owners of the lands and considers their ongoing connection with country. To assist in that endeavour, and to ensure the development considers the potential impacts to matters of Aboriginal heritage, ELA undertook an ACHA. The Aboriginal and scientific impacts of the Project will vary given the cultural connection to land and artefacts of Aboriginal people compared to the ‘scientific significance’. For example, Aboriginal communities may find any artefact, regardless of quality or location, to be culturally significant.

While the placement of WTGs within the landscape occupies a limited area, the foundations require disturbing the ground around the WTGs and therefore could impact ground-based matters of cultural heritage. The greatest potential for impacts to cultural heritage sites is likely to occur in locations that would have seen the highest frequency of occupation, namely watercourses and lowlands with abundant resources, as opposed to rocky outcrops and elevated ridgelines.

A total of 102 Aboriginal object sites were identified, with thirty-five (35) being identified within the development footprint and potentially impacted by the Project. The majority of sites have low overall significance and will be registered on AHIMS. Six (6) Aboriginal sites (BWF AS10, AS11, AS14, AS38, AS86 and AS88) were assessed as having moderate to high overall significance, and BWF IF2 being of high cultural significance and is to be avoided. The discovery of Aboriginal sites will assist in the formation of detailed design plans which seek to avoid impacts to cultural heritage values wherever possible, including on the Aboriginal site of high cultural significance. When implemented with appropriate care and respect for the importance of Aboriginal heritage, the proposed mitigation measures seek to avoid harm to sites of cultural heritage across the Project Site while providing clean, renewable energy for the future.

7.1.7. Historic Heritage

It is noted that the Project will, in some ways, create a contrast with the existing rural nature of the landscape associated with the rural, pastoral, and agricultural history of the area following European settlement. No Commonwealth, State or locally listed heritage items have been recorded within the Project Site. The Historic Heritage Impact Assessment undertaken by ELA identified two (2) derelict cottages within the Project Site and were not assessed as containing significant heritage value. No other historic heritage items or relics were recorded in the Project Site. Mitigation measures incorporated into the design process aim to provide safeguards in the instance additional historic heritage values are uncovered to avoid or limit impacts. Therefore, no significant impacts to historic heritage are anticipated by the Project.

7.1.8. Soils, Land Use and Agricultural Land

Designing the Project with impacts to land use and soils in mind, meant that as much as possible the Project was located on land previously cleared of native vegetation by previous agricultural development. An important component to the design of the Project is understanding the impacts the development will have within the landscape and optimising Project elements to utilise the least productive or capable lands. This means locating project elements on previously cleared land or areas of non-native vegetation, as well as on land with low land soil capability. The Project is proposing to host Project infrastructure largely on LSC Class Soils 6 and 7, occupying over 95% of the Development Footprint. Through Project Design, the Development Footprint will only impact approximately 3.4 ha of BSAL land with an LSC Class 3. This demonstrates a commitment of the Proponent to design a wind farm that is in line with ESD.

Therefore, impacts of the Project on agricultural production at a regional level are very minimal. At the conclusion of the life of the Project, the Project would be decommissioned to permit the resumption of grazing activities or other agricultural uses. Furthermore, the Project will assist in the delivery of the *Dubbo Local Strategic Planning Statement 2020* Priority 5 which aims to 'protect and enhance our agricultural industries and agribusiness'.

It is anticipated that the net outcome of the Project will be beneficial in nature, with limited agricultural impacts through detailed design, thoughtful care and consideration of stakeholders and the environment in which the Project is to be developed.

7.1.9. Surface Water, Groundwater, and Aquatic Ecosystems

While WTGs and their ancillary infrastructure typically avoid direct impacts to watercourses, the development of access roads will require several crossings in the forms of bridges and/or culverts. The design and construction of such crossings will be in line with the relevant guidelines to ensure they are done with minimal impact. KFH has been classified in Figure 6-62 to further aid in water crossing design during the detailed design phase.

A source, or sources, of water are needed for the Project for earthworks, turbine footings, transmission line footings and dust suppression during construction. Water requirements for construction will be met in accordance with the provisions of the WM Act by sourcing water from within the locality where practicable. Sources of water nearby are the Macquarie River, Cudgegong River, Burrendong Dam, and catchment farm dams (used for stock). If it is not practicable to source water locally, then it will be brought to the Project Site by external water suppliers under contract to the Project.

The MUSIC Model undertaken by ELA (2023e) concluded that pre and post-Project conditions showed no change in mean annual flows of catchment runoff and water quality runoff. An increase in runoff surrounding the Development Corridor is expected, however these may be localised and naturally ameliorated as flows combine with wider catchment runoff downstream thereby further reducing potential impacts. With the implementation of the recommended environmental management strategies, the Project can be developed with limited impacts to the surrounding water environment while producing renewable energy that does not contaminate water, something increasingly important given the scarcity of water in Australia.

7.1.10. Waste Management and Resources

Large developments such as the Project inevitably require large quantities of resources and produce large amounts of waste, requiring appropriate waste management. Given the rural setting of the Project, appropriate sourcing and waste disposal are important factors given the limited number of facilities that can provide appropriate services. Preliminary investigations have determined that there are several waste facilities within the Dubbo Regional Council and Mid-Western Regional Council that will be able to service the Project.

From a resource perspective, the construction phase will require water and materials to be sourced for the construction of roads, hardstands, and WTG foundations. The source of resources for construction is a commercial procurement decision which will occur post-Development Consent through licenced sources. During construction of the Project, the principles of the waste hierarchy will be implemented when determining ways in which the Project could avoid, reduce, and reuse resources wherever possible. The provision of renewable energy as able to create energy resources that provide more benefit than harm to the environment, including the waste created to generate power. The Project can be undertaken in a way that minimises waste while generating positive local, regional, and national benefits derived from wind power.

7.1.11. Social and Economic

The development of the Project is set to provide a myriad of social and economic benefits to numerous stakeholders, from the local level and across the state. The Project will create a number of jobs, primarily during the construction phase with a peak of 375 jobs required. This will provide a number of benefits to local communities where employment opportunities and economic stimulus through spent wages are often welcomed. On a macro level, the Project will inject millions of dollars into the NSW economy with a Capital Investment Value of approximately $320 million and an expected $21.4 million to be paid to the local economy and councils during the construction phase and over $190 million over the life of the Project, being 30 years. This is in addition to the Project injecting 450 MW of renewable energy into the electricity grid, helping NSW achieve net zero emissions by 2050. The economic stimulus associated with the Project will be in tandem with the myriad of social benefits expected for local communities and NSW more broadly.

The vast majority of social and economic impacts are anticipated to be beneficial to individuals and communities, with community consultation being undertaken to understand the questions and concerns present amongst members of the region. These considerations have helped shape the design process through incorporation of key concerns into the Project layout. Renewable energy projects are not without their concerns, with some stakeholders reasonably concerned about the perceived impacts on energy prices, changes to local values and landscape or the loss of native flora and fauna. As assessed throughout the EIS, some impacts as a result of the Project are anticipated to occur, though every effort will be made to avoid, minimise and mitigate any impacts. In terms of the social and economic impacts, most are anticipated to be beneficial to individuals and communities, primarily as a result of landholder agreements and community enhancement funds providing additional stimulus into rural communities. Extensive community consultation has occurred over a number of years in order to help guide the development of the Project appropriately. The consultation helped shape the design process and provided insight into key issues such as land use, biodiversity impacts and rural visual amenity. The Project has strived to be collaborative and supportive of the wider community, demonstrating that the development is not only designed in accordance with the Social Impact Assessment Guideline (DPE, 2023b) but in line with the Proponents desire to be a good corporate citizen.

When implemented with an inclusive, community focused approach to development and the goal of creating positive social and economic change to rural communities, the Project is set to delivery numerous benefits locally, regionally, and nationally.

7.2. Consistency of the Project with the Strategic Context

As the impacts of climate change increasingly put pressure on communities globally, the scope and scale of actions required to address them are increasing as well. An integral part in addressing climate change is the development of large-scale renewable energy to decarbonise the energy sector. Large scale wind energy is continuing to demonstrate its ability to effectively contribute to the task of decarbonisation, as demonstrated by the rapid increase in wind energy capacity added over the last decade (Figure 2-8, WWEA, 2022). The development of renewable energy projects such as the Project have the potential to positively contribute to myriad local, regional, state, and international efforts to combat the deleterious effects of a warming climate exacerbated by the burning of fossil fuels.

Calling for ‘rapid, deep, and immediate cuts’ to greenhouse gas emissions, the third instalment of the IPCC Sixth Assessment Report reinforces, and lays bare the immediacy with which changes to our energy systems and overall approach to climate change mitigation must happen. To limit global warming to around 1.5°C, global greenhouse gas emissions must peak by 2025 and halve by 2030 (IPCCb, 2022).

The Project, which seeks consent for a wind farm using modern renewable energy technology, complies with the objectives of Central West Orana Regional Plan and both the Dubbo and Mid-Western LSPS’ (Section 2.3). The Project has also been designed and assessed in accordance with The Wind Energy Guidelines (DPE, 2016a), the Visual Bulletin (DPE, 2016b) and the Noise Bulletin (DPE, 2016c). Furthermore, as discussed above in Section 7.1, the Development Corridor has been designed, where feasible, to avoid impacts to identified environmental constraints and nearby residences.

The combined economic stimulus to the region from host landowner returns (with a portion expected to be returned to the local community), neighbouring property returns, operational wage stimulus, and community and Council returns is estimated at approximately $190 million over 30 years (CPI adjusted). The Project is also likely to facilitate a Voluntary Planning Agreement that will finance community benefit funds to be administered by the Mid-Western Regional Council and Dubbo Regional Councils.

With an installed capacity of approximately 450 MW, the Project has the potential to provide sufficient renewable energy to support the annual electricity needs of the equivalent of approximately 247,000 NSW households, approximately 4 times the annual residential electricity requirements of the region.

The Project is well placed to be another essential tool in the implementation of impactful climate change mitigation and the transition to a low emission, clean energy future. The Proponent estimates 900,000 tonnes per annum in reduced CO2 emissions will result from the operation of the Project.

7.3. Compliance with Regulatory Framework

7.3.1. Ecologically Sustainable Development

The Commonwealth of Australia (1992) defines ESD as:

> *"Using, conserving and enhancing the community's resources so that the ecological processes, on which life depends, are maintained and the total quality of life, now and in the future, can be increased".*

ESD integrates social, economic, and environmental considerations into the decision-making process. The principal basis for ESD is that current and future generations should leave a natural environment that functions as well, or better, than the one inherited. The EP&A Regulation identifies four key principles to assist in the achievement of ESD, these are:

- The precautionary principle
- Inter-generational equity
- Conservation of biological diversity and ecological integrity
- Improved valuation and pricing incentive mechanisms.

Each of the principles of ESD with respect to the Project and its environmental impact assessment are considered in the following subsections.

7.3.1.1. Precautionary Principle

As defined within the EP&A Regulation, the Precautionary Principle states that:

> *If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.*

The potential for environmental impacts has been considered throughout the design and development of the Project. The potential impacts identified through the SEARs and Environmental Risk Assessment (Section 6.1) have been assessed as accurately as possible, using appropriate specialists in relevant disciplines where required. The assessment process involved computer modelling, scientific research, analysis, and interpretation of the potential environmental impacts associated with the Project during the construction, operational and decommissioning phases.

This process has enabled the impacts of the Project to be predicted with a reasonable degree of certainty. All predictions, however, contain a degree of variability and uncertainty, which reflects the nature of the environment. Where there has been any uncertainty in the prediction of impacts throughout the EIS process, a conservative approach was adopted to ensure the worst-case scenario was predicted in the assessment of impacts.

The Project is consistent with the precautionary principle in that where there was uncertainty, conservative overestimates where used, examples include:

- The LVIA (MLA, 2023; Appendix F) was based on the blade tip of each WTG being 250 m and solely based on topographic information. For this reason, impacts will potentially be considerably less than the worst-case scenario which has been assessed.
- The NVIA (MDA, 2023; Appendix G) utilised the WTG model with the highest sound power level, being the Vestas V172-6.2 MW, and assumed that all construction equipment would operate simultaneously on site for each stage of construction.
- Potential impacts were assessed assuming the use of a larger infrastructure footprint than will ultimately be constructed.
- Where potential threats to the environment have been identified, the Proponent has altered the Project design for avoidance or mitigation.
- Monitoring will be undertaken, as a precautionary measure to reduce the effect of any uncertainty regarding the potential for environmental damage.

7.3.1.2. Inter-Generational Equity

As defined in the EP&A Regulation, the principle of inter-generational equity states that:

> *The present generation should ensure that the health, diversity, and productivity of the environment are maintained or enhanced for the benefit of future generations*

Social equity involves value concepts of justice and fairness, so that the basic needs of all sectors of society are met and there is a fair distribution of costs and benefits to improve the well-being and welfare of the community, population, and society. Social equity includes inter-generational equity, which requires that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations.

The objective of the Project is to provide a source of renewable electricity that is safe and non-polluting. It will be able to be utilised by the community and help to reduce dependency on greenhouse gases. As such, the Project wholly fits in line with this principle as it has been deemed a necessary step in decreasing societal reliance on carbon-based energy sources. In turn, the addition of a new wind farm, because of the Project, will reduce overall greenhouse gas emissions and human contribution towards climate change. This will have a major positive impact on future generations.

Electricity generated from the Project would provide a clean electricity source for local and regional consumers in a cost-effective manner, providing improved opportunities and quality of life for all members of the regional community.

7.3.1.3. Conservation of Biological Diversity and Maintenance of Ecological Integrity

As defined in the EP&A Regulation, the principle of conservation of biological diversity and ecological integrity states that:

> *Conservation of biological diversity and ecological integrity should be a fundamental consideration.*

Biological diversity refers to the diversity of genes, species, populations, communities and ecosystems, and the linkages between them. Maintaining biological diversity safeguards life support functions within the environment and can be considered a minimal requirement for inter-generational equity.

The conservation of biological diversity and ecological integrity has been considered and integrated at all stages of the Project. The proposed Project has been assessed for its biological and ecological impacts which are discussed in detail in Section 6.5. Areas of higher conservation value have been avoided during the evolution of the Project Design where possible. Where identified impacts are unavoidable, they will be managed by the implementation of mitigation measures, including the purchase and retirement of both ecosystem and species credits as per the requirements of the BC Act. At the conclusion of the 30-year operational lifespan, the Project equipment will either be replaced, or the Project shall be fully decommissioned, and the site rehabilitated.

7.3.1.4. Improved Valuation and Pricing of Environmental Resources

As defined within the EP&A Regulation, the principle of improved valuation and pricing of environmental resources states that:

> *Environmental factors should be included in the valuation of assets and services, such as:*
>
> i. polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance, or abatement;
> ii. the users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste; and
> iii. environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems

The environment has conventionally been considered a free resource, with the true cost to the environment not factored into the cost of production or use of the resource. This principle involves placing a monetary or social value on the environment that ultimately increases its value in order to decrease future exploitation.

The Project recognises and makes use of the inherent value in wind energy. This converts an abundant, renewable and zero emissions resource (wind) into a valuable and critical commodity (electricity). Furthermore, continued analyses on the total lifecycle cost of various forms of energy demonstrate wind energy generation has one of the lowest 'costs' on the environment while providing one of the greatest energy benefits (Section 2.4.1).

The commitment to offset impacts to native vegetation and to fund future biological conservation activities through the BDAR recognises and places an appropriate monetary value on environmental protection and the maintenance of biodiversity.

7.4. Incorporation of Community Engagement into the Project Design

Since 2018, Ark Energy has understood the importance and benefit to all parties of effective and comprehensive stakeholder and community consultation. Particularly in how active participation by community members can positively influence the final design of the Project. From the outset, consultation has sought to address concerns and where possible, incorporate consultation input into the proposal to improve the Project outcomes and community benefits. As discussed in Section 5.3, various channels of communication were utilised to involve community members and gain an understanding of community views. In summary, the community and traditional owners raised concerns regarding the following:

- The issue of land claims.
- Heritage field surveys.
- Visual impacts to surrounding areas.
- Noise impacts because of the WTG infrastructure.
- Negative changes to property values.
- Alterations to road design and traffic impacts.
- Increase in dust impacts due to construction.
- Increased and impacted traffic times due construction.

The proposed Project Layout has seen considerable alterations since 2018, as discussed in Section 2.5. During that period, WTG technology has evolved and improved, allowing a smaller number of WTGs to generate similar or more energy that technology at the time of project conception. Over the course of the Project to date, the Project has undergone several reviews and design changes to incorporate the outcomes continued community consultation. This consultation has contributed to a design that satisfies the avoid-minimise-mitigate hierarchy and remains an important ongoing component of the Project, which will continue should it be approved.

7.5. Monitoring Compliance

Once all required permits and approvals have been obtained, secondary approvals will be acted upon including the approval of the EMS and associated management plans as well as an application for an EPL and other relevant authorisations outlined Table 4-1. A tender process will occur concurrently to procure bids for the supply and installation of WTGs and associated/temporary infrastructure. This process will consider each tenderer’s record of environmental management and compliance performance to ensure that they are able to achieve the required specification of works.

Furthermore, the EMS and associated management plans will have a dedicated process for environmental inspections, monitoring and auditing, as outlined below.

7.5.1. Environmental Inspections

The Proponent will implement a regular program of environmental inspections through development of a checklist, which will:

- Provide a surveillance tool to ensure that safeguards are being implemented.
- Identify where problems might be occurring.
- Identify where sound environmental practices are not being implemented.
- Facilitate the identification and early resolution of problems.

Deficiencies and required actions will be analysed and prioritised at the completion of the inspection and timeframes for implementation of corrective actions agreed. Any non-conformances identified through the checklist process will be highlighted and an environmental inspection report (minor issues) or an environmental incident report completed.

7.5.2. Monitoring

Environmental monitoring will be used to measure performance of the EMS and compliance with relevant statutory requirements. The Project Environmental Officer will conduct regular internal monitoring during construction to ensure the contractors are complying with their commitments and the relevant conditions of approval. Environmental monitoring checklists will be developed, and environmental inspections will include evaluation of performance against objectives and targets identified in the environmental management plans and programs.

7.5.3. Auditing

The Proponent will commission an independent Environmental Audit of the Project, when required, in accordance with the conditions of approval. A copy of the audit report will be submitted to the Secretary, and any other NSW agency that requests it, together with a response to any recommendations contained in the audit report, and a timetable for the implementation of the recommendations.

The Independent Environmental Auditor will prepare the audit program in accordance with the DPE Post-approval requirements for State significant developments Independent Audit Guidelines (DPE, 2015) and in accordance with the principles of AS/NZ ISO 19011:2003 – Guidelines for Quality and/or Environmental Management Systems Auditing.

7.6. Key Uncertainties

Uncertainty in EIS assessment is based on any limitations to the knowledge, resources, or time available to assessors when conducting an assessment. Examples of uncertainties that may be encountered include:

- Limitations in the quality and representativeness of data
- Predictive modelling techniques
- Utilisation of default factors.

Throughout the EIS process, assessors have worked to provide data and assessments that are as accurate as possible. However, the Proponent acknowledges that even under the robust and thorough assessment conditions, some predictions and assumptions have had to be made. This is the result of factors including a lack of specific information regarding plant and materials or the limitations of conceptual models used in the LVIA (MLA, 2023; Appendix F). As a precautionary approach, where instances of uncertainty were found to occur, worst-case scenarios were assessed. Below are examples of how key uncertainties were factored into the assessments.

7.6.1. Biodiversity Development Assessment Report

Regarding determining the impact of the WTGs on bird and bat populations, the principal limitations relate to data on bird and bat behaviour and characteristics. Accordingly, assumptions are typically required to be made for almost all variables relating to birds and bats, including:

- Populations numbers
- Numbers of movements they make
- Heights and speeds at which they fly; and the
- Timing and likelihood that species might inhabit or visit a particular site.

However, this limitation is thought to be adequately mitigated through the preparation and implementation of the BBAMP, which will allow for the precited modelling to be assessed with on-ground monitoring throughout the operation of the Project. This in turn will provide real-life scenarios that can be used for future wind farm developments.

7.6.2. Aboriginal Cultural Heritage Assessment

The ACHA (ELA, 2023c; Appendix N) was conducted based on a level of scientific significance and does not reflect the level of cultural significance that the sites have for the Aboriginal Community. Given the unique and long held connection to Country of the Wiradjuri People, the cultural significance of areas within the Project Site are unlikely to be fully understood by the Proponent or wider community. In recognition of the cultural significance of the Project Site, the methodology was developed to allow for the identification of elements representative of the patterns of social life and how these may vary across the landscape. The rationale behind this approach is that artefacts may be directly observed while 'sites' are a construction within an interpretive process. The density and nature of the artefact distribution will vary across the landscape as several behavioural factors influence artefact discard. Ultimately, the nature of archaeological studies is dependent on factors that limit the ability to uncover archaeological sites and material. The goal with surveys conducted within the ACHA are to minimise all impacts to matters of Aboriginal heritage while gaining as clear an image of the abundance of heritage material within the Project Site.

7.6.3. Landscape and Visual Impact Assessment

The visual magnitude assessment undertaken in the LVIA (MLA, 2023; Appendix F) uses a tool to identify areas where the Project (blade tip) may be visible within the landscape. The tool, however, is limited as it uses a bare ground scenario that is unable to account for objects in the landscape. This includes trees, structures, or other objects in real life that may obstruct or obscure views and affect the results. In utilising the worst-case scenario approach, in part using this model, the potential visual impacts outlined in Section 6.3 are anticipated to be greater than what will be observed in the landscape.

7.6.4. Noise and Vibration Impact Assessment

To appropriately assess the potential noise impacts generated by the Project during operation, it is important to understand the baseline (or background) noise levels found in the environment prior to development. The NVIA (MDA, 2023; Appendix G) undertook background noise monitoring surveys to obtain a representation of the baseline conditions from which to assess Project components against and determine whether the noise generated will likely be within the required thresholds. While the predictive modelling used, in accordance with the international standard ISO 9613-2 (Part 2) is considered sufficiently conservative when calculating sound propagation, there are limitations regarding the accuracy of the prediction method. This can be a result of incomplete background monitoring data among other factors.

7.7. Conclusion

The Proponent proposes to develop a wind farm that strongly aligns with the principles of ESD, particularly regarding striving for intergenerational equity. Providing a clean and reliable energy source for both current and future generations, that also align with local, state, and national targets on reducing fossil fuel consumption, will help to drive positive change in combatting climate change.

The Project would have an electricity generating capacity of approximately 400-500 MW at the point of connection. This would produce enough energy to power the homes of approximately 247,000 NSW households each year. In terms of emissions reduction, the amount of clean energy produced would displace 900,000 tonnes of CO_2-e annually.

As the Project is energy generating works and has a capital investment of over $30 million, it is recognised as SSD and is therefore subject to assessment under Division 4.7 of the EP&A Act. This EIS has examined and considered all matters affecting or likely to impact the environment because of the Projects development, including consideration of Commonwealth EPBC Act listed MNES.

Engaging with the community and actively consulting with stakeholders is essential in developing a renewable energy project that will provide benefits for everyone. To that end, the Proponent has sought to engage with the local community early in the planning process and shared information extensively through a variety of means. Issues raised by community members during the consultation process have been addressed throughout the evolution of the design and detailed throughout the EIS, particularly in Section 5 and Section 6.13. The importance of integrating feedback from stakeholders is well demonstrated in the removal of over 50 WTGs. This reduction of WTGs demonstrates the Proponents desire to develop a Project in the context of the Avoid, Minimise, Mitigate, Offset hierarchy development concept. Potential environmental impacts because of the Project have, in the first instance, been avoided, and then reduced during the concept development phase. Where impacts are not able to be avoided or minimised sufficiently, mitigation measures have been developed to further dampen any deleterious impacts as detailed in Appendix E. It is understood that in the absence of avoidance, minimisation and mitigation, the Project is likely to result in some impacts on matters such as biodiversity through vegetation clearing, soil and water erosion, noise impacts due to plant and construction, changes to visual amenity and traffic impacts because of increased vehicle movements.

At the same time that the Project seeks to avoid and minimise all potentially negative impacts, it is also poised to provide numerous benefits across a range of receptors. Particularly, regarding the economic contributions. The Project is expected to employ on average 250 FTE jobs during the construction phase, with a peak of 375 FTE jobs. The operational phase will provide an additional 12 direct FTE jobs, with increased stimulus expected in the broader community as workers spend a portion of their income in the communities surrounding the Project Site. As discussed above, the Project is also set to avoid 900,000 tonnes of $CO_{2\text{-}e}$ annually demonstrating progress towards state and national policy on emissions reduction while promoting the development of renewable energy in regional Australia.

In total, based on the detailed assessments contained within the EIS, the Project presents relatively minor and manageable environmental impacts when compared to the enormous benefits across a range of factors and stakeholders. The impacts detailed in the EIS can in large part be effectively mitigated using best practice strategies and methodologies and continuing to centre the importance of communication and consultation with relevant parties to ensure the Project provides beneficial outcomes for all those involves.

CHAPTER 8

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