Environmental Impact Statement

Uungula Wind Farm

Appendix R: Landscape and Visual Impact Assessment (Moir Landscape Architecture, 2020)

May 2020

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Landscape and Visual Impact Assessment

Proposed Uungula Wind Farm

moir landscape architecture

Prepared for: CWP Renewables Pty Ltd

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Executive Summary

Moir Landscape Architecture have been commissioned by CWP Renewables Pty Ltd to prepare a Landscape and Visual Impact Assessment (LVIA) for the proposed Uungula Wind Farm.

Uungula Wind Farm (the Project) is proposed to be located between Wuuluman and Twelve Mile, approximately 14 km east of Wellington, NSW. The Project consists of the installation, operation, maintenance and decommissioning of up to 97 Wind Turbine Generators (WTGs), ancillary infrastructure and temporary facilities.

The Project has was publicly announced in March 2011, with a proposed 330 wind turbines, however due to a prolonged period of market uncertainty the Project went into a period of monitoring and maintenance. As a result of an appetite from industry and community to adopt more renewable energy in recent years, the development of the Project was reinvigorated under updated legislation and guidelines including the NSW Wind Energy Guideline (DPE 2016).

Throughout the development period, the Proponent has been in consultation with the local community, Councils, agencies and other stakeholders. The lengthy development period has enabled a detailed understanding of stakeholder views and concerns to be established. As a result of an iterative Project design, the number of proposed turbines has been significantly reduced to a maximum of 97 wind turbines. This has resulted in significant reductions in the potential for impacts on the surrounding landscape and residences.

SEARs were issued by the Department of Planning and Environment in December 2016 and revised SEARs were issued in November 2019. Moir Landscape Architecture have formulated a quantitative study methodology with regards to the guidelines of the Wind Energy: Visual Assessment Bulletin (the Bulletin). Relevant literature and guidelines relating to large scale energy projects and Moir Landscape Architecture's previous experience on large scale infrastructure projects has also been considered in the Study Method.

The LVIA includes a comprehensive assessment of the existing landscape character, scenic quality and visibility of the Project. Visual influence zones have been established from viewpoints and sensitive receptors and assessed against visual performance objectives outlined in the Bulletin.

The assessment determined the regional landscape character is typical of the Central West region characterised by agricultural land utilised for grazing, cropping with some areas of remnant vegetation. The landscape was categorised into seven (7) Landscape Character Units (LCUs). A quantitative frame of reference was applied to establish the Scenic Quality Rating of these LCUs which ranged from a low to moderate. The Scenic Quality Ratings are utilised in defining the Visual Influence Zones as per the Bulletin.

Due to the scale of the proposed wind turbines, the Project has the potential to be a visually prominent element in the landscape. However, there are limited opportunities to view the Project in its entirety. This is mainly due to the siting within an undulating landscape and the isolated location which is generally only accessed by a small number of landowners.

Other key factors which form a part of the existing landscape character would reduce the potential for viewing. These include roadside vegetation, riparian vegetation along creek lines and rivers, pockets of remnant vegetation and screen planting surrounding residences.

The assessment, in conjunction with community consultation identified the key landscape features within the catchment. These include (but are not limited to) vegetated ranges, Lake Burrendong, Cudegong River and Macquarie River. The assessment found it was unlikely the Project would have an significant negative impacts to the dominance of these key visual features of the landscape from the viewpoints assessed.

Renewable energy projects have also entered the landscape character of the area, including the operational Bodangora wind farm located 7 km north of the project site and the operational Beryl solar farm located 30 km east. Other approved, but yet to be constructed solar farm developments are also located in proximity to the Project, including the Wellington Solar Farm. An assessment of the cumulative visual impact of the Bodangora Wind Farm found very limited opportunities to view the two wind farms simultaneously.

The LVIA assessed the potential visual impact of the Project for the majority of residences within the Projects viewshed. A number of criteria were considered and assessed against the objectives of each Visual Influence Zones to determine levels of visual impact. There are a number of residences which have the potential to have visual impacts, however in the context of a project of this scale it is believed that the Project could be sufficiently mitigated and managed to an acceptable level.

The assessment identified ten (10) non-associated residences with the potential to be impacted by the Project and identified mitigation methods which are likely to assist in significantly reducing any negative impacts resulting. Mitigation measures in keeping with the existing character include off site screen planting and supplementary planting of existing vegetation. While these mitigation methods are considered appropriate to minimise the visual effects for a number of these residences, it is acknowledged that there are some residences, mitigation methods may not be suitable due to their elevated locations and expansive views over the landscape.

An evaluation of the Project against the visual performance objectives found that in the context of the scale of the Project, the impacts of the Project are considered to be acceptable.

1.0 Introduction

1.1 Introduction

Moir Landscape Architecture have been commissioned by CWP Renewables Pty Ltd to prepare a Landscape and Visual Impact Assessment (LVIA) for the proposed Uungula Wind Farm. Uungula Wind Farm (referred to through this report as 'the Project') is proposed to be located between Wuuluman and Twelve Mile, approximately 14 km east of Wellington, NSW.

The Project consists of the installation, operation, maintenance and decommissioning of up to 97 Wind Turbine Generators (WTGs), ancillary infrastructure and temporary facilities.

The purpose of this report is to provide a comprehensive assessment of visibility and potential visual impacts associated with the Project on the landscape character, landscape values, landscape amenity and any scenic vistas. This information will assist the community and the Department of Planning, Industry and Environment (DPIE) to understand and assess the likely visual impacts.

Survey work for the study was undertaken during October and November 2018. The report details the results of the field work, documents the assessment of the landscape character and visual setting, and makes recommendations to assist in the mitigation of any potential impacts resulting from the proposed development.

1.2 Relevant Experience

Moir Landscape Architecture Pty Ltd is a professional design practice and consultancy specialising in the areas of Landscape Architecture, Landscape Planning and Landscape and Visual Impact. Our team has extensive experience in undertaking Landscape and Visual Impact Assessments for large scale infrastructure projects, including the mining industry, sustainable energy sector and commercial / residential developments in visually sensitive areas. Our capabilities include digital terrain modelling, viewshed assessment, photo montage development, landscape character assessment and community consultation.

Our team has extensive experience in undertaking Landscape and Visual Impact Assessments for wind energy projects. In the context of our experience and with guidance from the *Visual Assessment Bulletin* we have developed methodologies to ensure a comprehensive and qualitative assessment of the Project. Relevant experience includes the preparation of Landscape and Visual Impact Assessments for the following Wind Energy Projects:

- *Crudine Ridge Wind Farm (New South Wales)*
- *Bodangora Wind Farm (New South Wales)*
- *Capital II Wind Farm (New South Wales)*
- *Lord Howe Island Wind Turbines (New South Wales)*
- *Cherry Tree Wind Farm (Victoria)*
- *Lakeland Wind Farm (Queensland)*

2.0 Study Method

2.1 SEARs

The Project is a State Significant Development (SSD). Applications of this scale are determined by the Minister for Planning under the Environmental Planning and Assessment Act 1979.

Secretary's Environmental Assessment Requirements (SEARs) issued in November 2019 for the Project state *"the EIS must 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 Wind Energy: Visual Assessment Bulletin (DPE, 2016)".*

A brief overview of the requirements of the *Wind Energy: Visual Assessment Bulletin for State Significant Wind Energy Development* (referred to hereafter as 'the Bulletin') is outlined in ***Section 2.2***.

2.2 Wind Energy: Visual Assessment Bulletin

The *Wind Energy: Visual Assessment Bulletin for State Significant Wind Energy Development* (referred to hereafter as 'the Bulletin') was prepared by the Department of Planning and Environment in December 2016. The Bulletin has been developed to guide the appropriate location of wind energy development in NSW and to establish an assessment framework for the assessment of visual impacts associated with wind energy. Visual impacts are one of a range of issues considered in the assessment and determination of wind energy projects.

The objectives of the Bulletin are to:

- provide the community, industry and decision-makers with a framework for visual impact analysis and assessment that is focused on minimising and managing the most significant impacts;
- facilitate improved wind turbine and ancillary infrastructure siting and design during the pre-lodgement phase of a project, and encourage early consideration of visual impacts to minimise conflicts and delays where possible, and provide for a better planning outcome;
- provide the community and other stakeholders with greater clarity on the process along with an opportunity to integrate community landscape values into the assessment process; and
- provide greater consistency in assessment by outlining appropriate assessment terminology and methodologies.

2.3 Overview of the Study Method

In accordance with the Visual Assessment Bulletin, the visual assessment will include:

- a baseline study that includes analysis of the landscape character, scenic quality and visibility from viewpoints of different sensitivity levels;
- establish visual influences zones from viewpoints using data collected in the baseline study;
- assessment of the proposed layout against visual performance objectives; and
- justification for the final proposed layout and identification of mitigation and management measures.

Moir Landscape Architecture have formulated a quantitative study methodology with regards to the Visual Assessment Bulletin and with consideration of previous experience on large scale infrastructure projects and relevant literature and guidelines relating to large scale energy projects.

2.4 Additional Literature

In addition to the Bulletin, the following literature has assisted in the formulation of the study methodology:

- *Clean Energy Council, Best Practice Guidelines for Wind Energy Development (June, 2018)*
- *Scottish Natural Heritage, Visual Representation of Wind Farms - Good Practice Guidance (February, 2017)*
- *Australian Wind Energy Association and Australian Council of National Trust, Wind Farms and Landscape Values: Stage One Final Report – Identifying Issues Exploring Community Acceptance of Rural Wind Farms in Australia (2005)*
- *Environment Protection and Heritage Council, Draft National Wind Farm Development Guidelines (July 2010)*
- *Draft NSW Planning Guidelines Wind Farms (December 2011)*

2.5 Report Structure

Table 1 provides an outline of the report structure, a brief overview of the objectives of the Bulletin and a summary of how these have been addressed in the LVIA. Detailed methodologies for each part of the assessment have been included in the relevant chapters of the report.

2.0 Study Method

Landscape and Visual Impact Assessment Report Structure	
Section 3.0: Project Overview	**Visual Bulletin Requirements Addressed:**
• Detailed Project Description • Wind Turbine Design • Associated Infrastructure	• *The VIA is to include a full description of the proposed wind energy project design, the layout, structural elements and scenarios being considered.*
Section 4.0: Community Consultation	**Visual Bulletin Requirements Addressed:**
• Community Consultation Process • Community Landscape Values • Community Perception	• *The proponent is to further consult with the community to verify the community consultation findings from the scoping and design stage.*
Section 5.0: Existing Landscape Character	**Visual Bulletin Requirements Addressed:**
• Detailed assessment of Landscape Character and Key Features of the Region • Landscape Character Unit Classification • Application of Scenic Quality Class Ratings	• *A visual baseline study must be undertaken to establish the existing landscape and visual conditions. The baseline study is prepared and evaluated by the proponent prior to undertaking any visual analysis.* • *Describe, assess and map these factors in written and graphic forms supported by photographic representations of the area.* • *Identify Scenic Quality Classes*
Section 6.0: Visual Catchment	**Visual Bulletin Requirements Addressed:**

Define the Visual Catchment of the Project:
• Preliminary Assessment Tools:
  • Visual Magnitude
  • Multiple Wind Turbine Effect
• Zone of Visual Influence
 	
Refer to Appendix B - Preliminary Assessment Tools
	• *Visual Magnitude Assessment: Mapping the dwellings, key viewpoints and proposed turbines at scale to establish the potential visual magnitude.*
	• *Map into six sectors of 60º any proposed turbines and any existing or approved turbines within each dwelling or key public viewpoint.*
	• *Establish the theoretical 'zone of visual influence' of the proposal (the area from which the proposal is theoretically visible or the 'visual catchment').*

Section 7.0 - Viewpoint Analysis	**Visual Bulletin Requirements Addressed:**
Assessment of viewpoints from areas identified within the visual catchment. • Viewpoint Selection and Assessment • Establish Zone of Visual Influence for each viewpoint (see Appendix A for methodology) • Assess each viewpoint with regards to visual performance objectives. ***Refer to Appendix C - Viewpoint Analysis***	• *All key public viewpoints and individual dwellings within the 'visual catchment' should be identified and assessed.* • *The visual performance objectives form the principle framework and guide for assessing the proposed wind energy project when applied to individual viewpoints.*

Landscape and Visual Impact Assessment Report Structure (continued)	
Section 8.0: Photomontages	**Visual Bulletin Requirements Addressed:**
• Photomontage selection process • Photomontage development process **Refer to Appendix D - Photomontages and Wireframe Images**	• *Photomontages shall be prepared in accordance with the Scottish Natural Heritage Visual Representation of Wind Farms.* • *The visual assessment needs to include a concise description of the complete methodology used to create any photomontages presented in the visual assessment.*
Section 9.0 Cumulative Visual Impacts	**Visual Bulletin Requirements Addressed:**
Assess the potential cumulative effects on the immediate and broader regional context it forms part of. • Approved wind farm developments • Assessment of Bodangora Wind Farm	• *address potential cumulative impacts of wind energy projects in the region (the wind energy project as well as existing and approved projects).*
Section 10.0 Shadow Flicker, Blade Glint and Lighting	**Visual Bulletin Requirements Addressed:**
• Shadow Flicker Assessment (Section 10.1) • Blade Glint Assessment (Section 10.2) • Night Lighting Assessment (Section 10.3)	• An assessment of the number of hours of potential 'shadow flicker' • Blade Glint • Consider whether any obstacle lighting required is likely to result in any significant increase in visual impacts.
Section 11.0 Visual Impact Overview	**Visual Bulletin Requirements Addressed:**
• Overview of LCUs with regards to Visual Performance Objectives • Summary of impact on Landscape Character • Summary of impact on Dwellings • Summary of impact of associated infrastructure	• Assess the Project using visual performance objectives.
Section 12.0 Mitigation Methods	**Visual Bulletin Requirements Addressed:**
• Wind Farm Design • Mitigation Methods for Residences • Associated Infrastructure • Lighting	• An outline of any mitigation and management options proposed, including consultation with affected property owners regarding the proposed mitigation works
Section 13.0 Visual Performance Evaluation	**Visual Bulletin Requirements Addressed:**
• Evaluation of Visual Performance Objectives	• An assessment of the proposed wind energy project against each visual performance objective and demonstration of whether each objective is achieved and how the standard has been achieved.

Table 1: **Landscape and Visual Impact Assessment Report Structure**

2.0 Study Method

2.6 Policy Considerations

Local Government Policies

As the proposal is considered a State Significant Development and will be assessed as such by the *NSW Department of Planning Industry and Environment* (DPIE), however relevant local government policies are to be considered. The proposed development is situated within the Dubbo Regional Council Local Government Area (LGA). Dubbo Regional Council have no relevant policies or guidelines relating to the visual landscape or scenic quality which apply to the area.

NSW Roads and Maritime Services

The assessment of shadow flicker, blade glint and reflectivity is to include an assessment of the impact on road users. This has been included in ***Section 10.1 and 10.2*** of this LVIA.

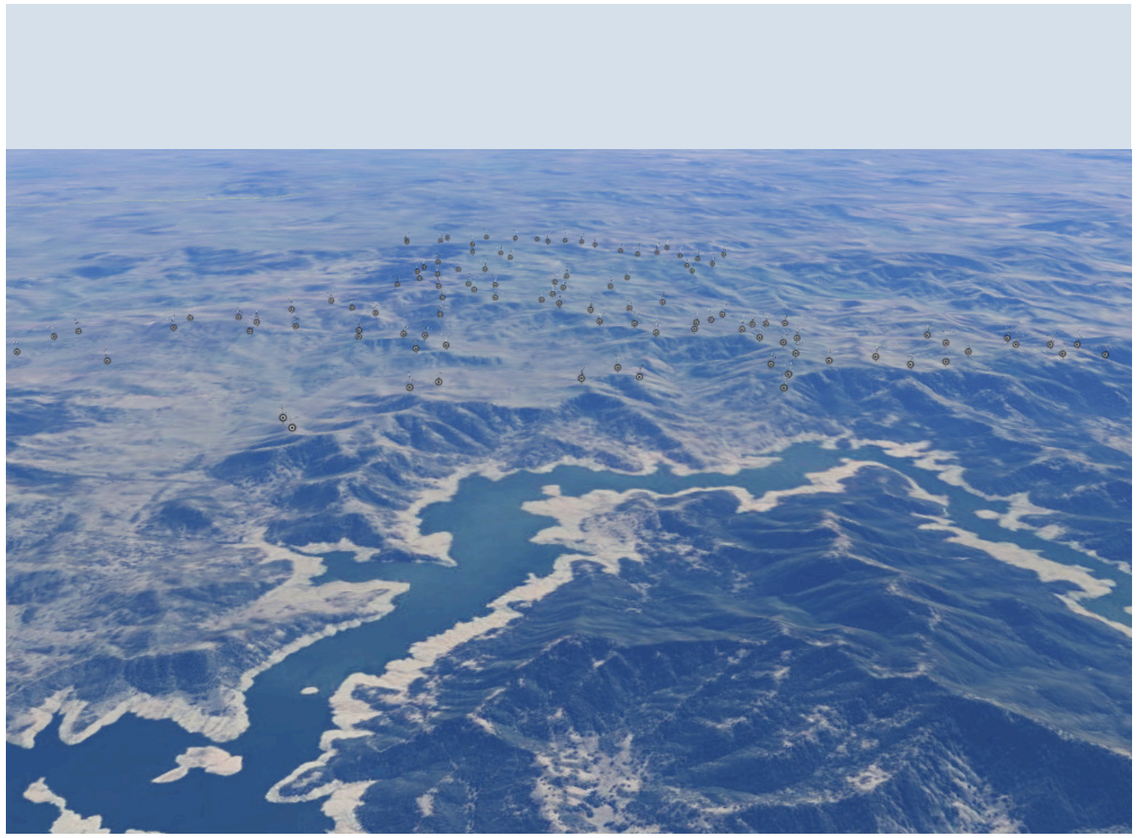
Civil Aviation Safety Authority

The LVIA includes an assessment of potential visual impact associated with night lighting in accordance with the Civil Aviation Safety Authority (CASA). Refer to ***Section 10.3*** of this LVIA.

3.0 Project Overview

3.1 The Project Site

Uungula Wind Farm (referred to hereafter as 'the Project') is proposed to be located in the Central-West Renewable Energy Zone (REZ), within the Dubbo Regional Council Local Government Area, approximately 14 km east of Wellington, NSW (see ***Figure 1***). The Site is generally characterised by undulating land which has been predominately cleared for grazing purposes. A small number of unsealed roads provide access through Site, generally following creeklines or valley floors.



Birds Eye Aerial of the Study Site (Source: Google Earth)

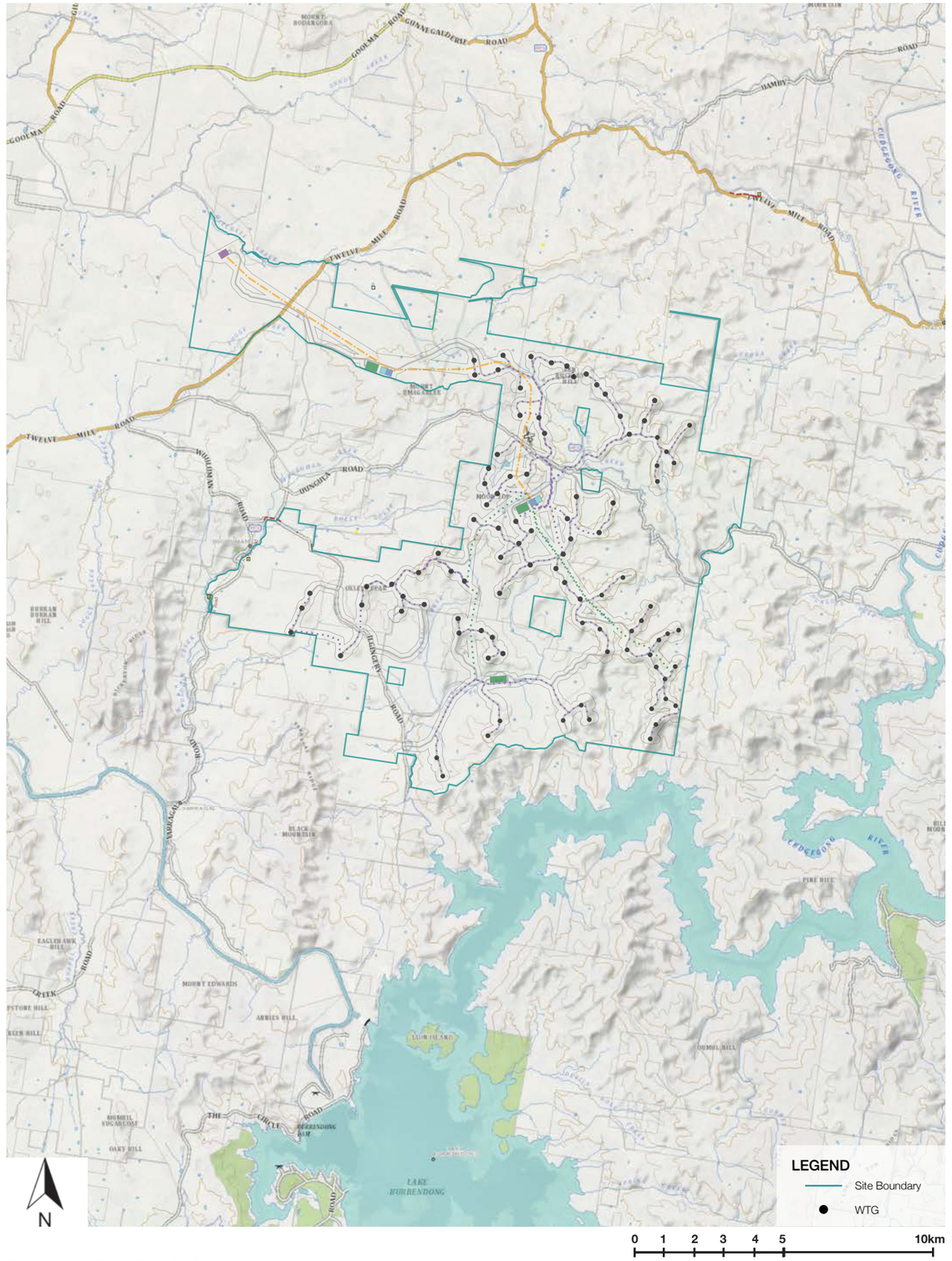


Figure 1: ***The Study Site***

3.0 Project Overview

3.2 The Proposed Development

The Project generally consists of the installation, operation, maintenance and decommissioning of up to 97 Wind Turbine Generators (WTGs), an Energy Storage Facility (ESF), Ancillary Infrastructure and Temporary Facilities. The Project is designed to accommodate a contemporary WTG of up to 250m in height with a nameplate capacity of approximately 4 megawatts (MW) or greater. On these terms, and remaining subject to Development Consent and market changes, the Project is estimated to have an installed generating capacity of approximately 400 MW.

Figure 2 illustrates the Project layout.

The environmental assessments leading into the EIS has resulted in avoided impacts and further mitigated impacts by adjusting infrastructure design with multiple design iterations since the Project was announced. The EIS has considered the worst-case impacts for the resultant Project elements to ensure that the Project can be constructed, operated, maintained and decommissioned within the bounds of a typical wind farm Development Consent, and generally in accordance with this EIS.

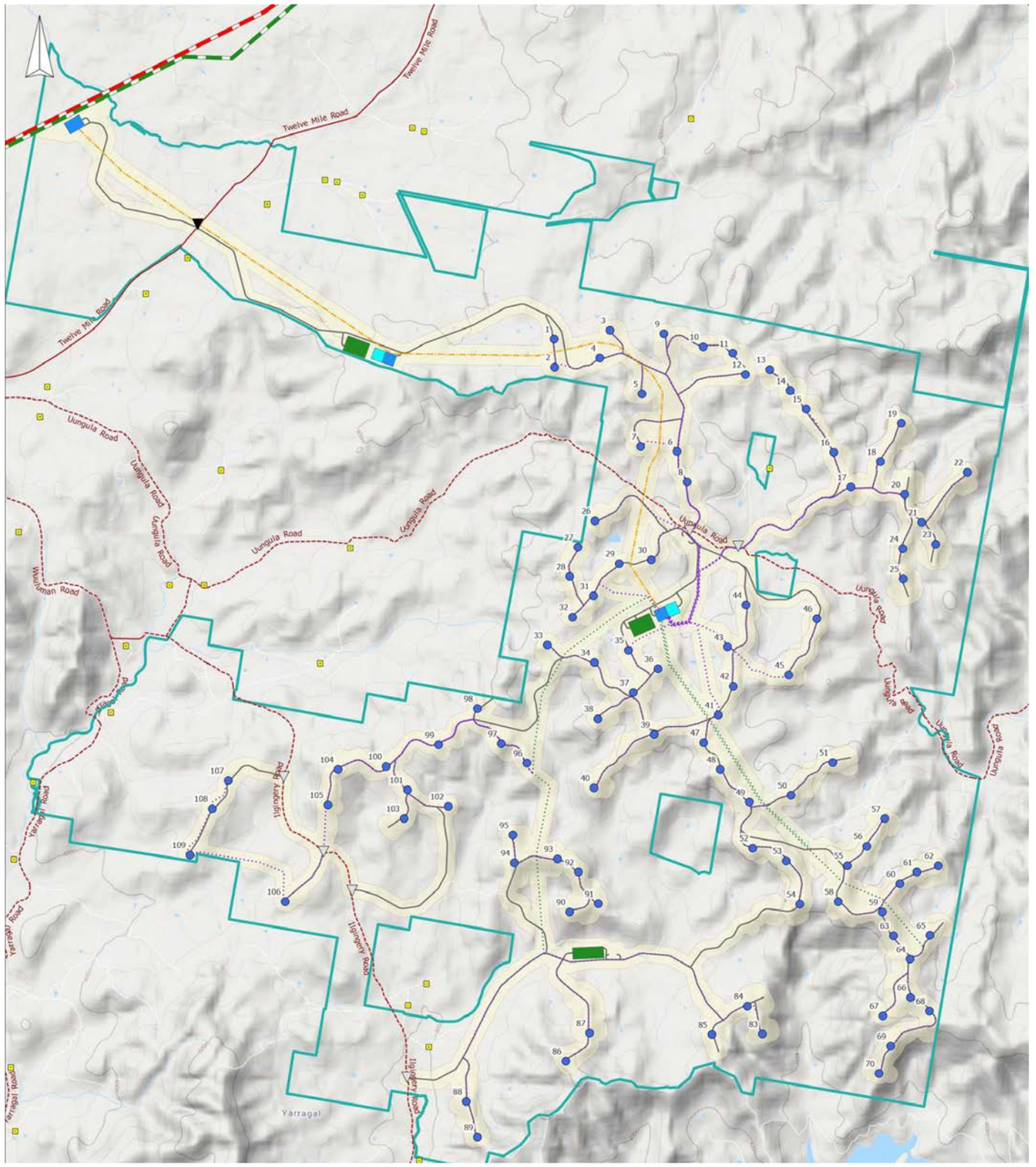


Figure 2: The Project Layout (Source: CWP)

3.0 Project Overview

3.3 Wind Turbine Design

The following provides an overview of all aspects of the Project design to be considered in this LVIA.

3.3.1 Wind Turbine Generators

For the purpose of this Landscape and Visual Impact Assessment report a Wind Turbine Generator (referred to as WTG or 'turbine') height of up to 250m and a blade length of up to 85m has been used for visual analysis to represent a worst case scenario (see ***Table 2***). Market trends and forecasts from WTG manufacturers indicate that WTGs entering the Australian market in 2021 will rise to up to 240-250m from the ground to upper blade tip. By way of example the Vestas V126 3.6 MW machine (as installed at the Sapphire Wind Farm near Inverell, NSW - see ***Image 1***) was the largest WTG in Australia in 2016 standing at a tip height of 200m, and is expected to be superseded by larger more efficient models by 2021.

Wind Turbine Components		
Project Component	**Approx. Dimensions**	**Quantity**
WTG Height	Up to 250m	**97**
Rotor Diameter	Approx. 170m	
Uppermost Blade Tip	250m	
Tower (hub) height	125 - 166m	
Footings	Approx. 27m diameter	

Table 2: Wind Turbine Components

Foundations

A typical foundation size of approximately 27m in diameter is being considered as worst case for the Project which reflects the largest known foundation impact based on currently available WTGs.

Generator Transformer

WTGs typically produce electricity at low voltage which is stepped up to medium voltage (33 kV or greater) by the transformer typically located either in the nacelle or the base of the tower, or adjacent to the base of the tower on a concrete pad. ***Image 4*** shows an example of a transformer located outside of the tower. The footprint of the transformer is marginal as it would sit on the WTG footing and/or the hardstand and assembly area.

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 50 m x 40 m, however is likely to vary dependent on detailed design, topography, construction methods and chosen WTGs. (See ***Image 2 and 3***)

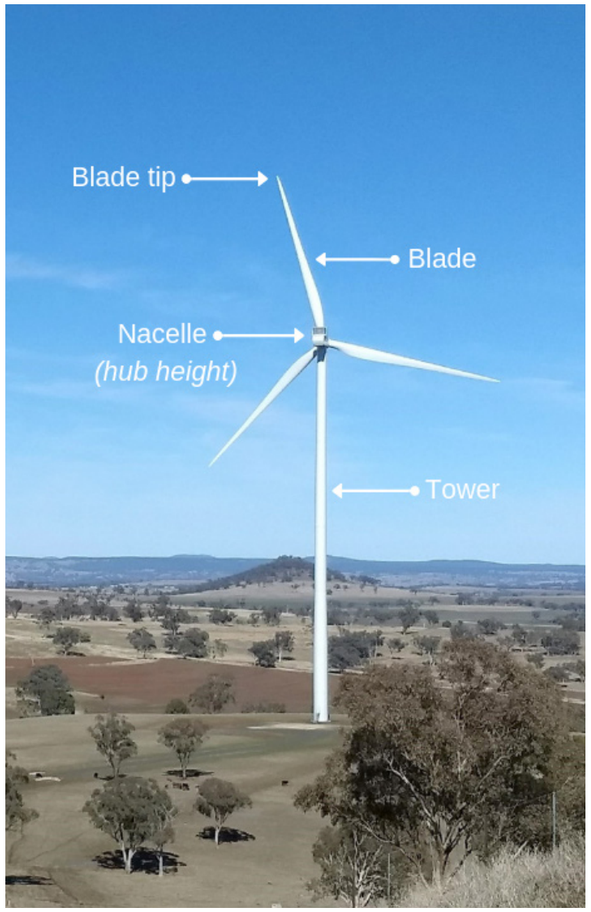


Image 1. Typical Wind Turbine Generator (WTG)
(Image Source: 200m high WTG Installed at Sapphire Wind Farm CWP Renewables)

Image 2. Typical Wind Turbine during construction
(Source: CWP Renewables)

Image 3. Typical Hardstand Area
(Image Source: CWP Renewables)

Image 4. Typical Generator at base of WTG
(Image Source: CWP Renewables)

3.0 Project Overview

3.4 Associated Infrastructure

In addition to the Wind Turbines, the following provides an overview of the associated infrastructure components proposed for Uungula Wind Farm which may contribute to the visual impact of the proposal. An assessment of the potential visual impacts resulting from the associated infrastructure has been provided in **Section 11.11** of this report.

Project Component	Approx. Dimensions	Quantity
Substations	220 x 160 m	Up to 3
Operations and Maintenance (O&M) Compounds	100 x 100 m	1 or more
Wind monitoring masts	Up to hub high	6
Internal Roads	100kms in length	-

***Table 3:* Associated Infrastructure**

Operations and Maintenance Compound

One or more operations and maintenance (O&M) compounds will be established for the day to day operation of the Project and would take up an area of approximately 100 x 100 m or 1 ha (see ***Image 6***). Three potential locations for the compounds have been identified in ***Figure 2***. Each O&M Compound may include lay down areas, site operations facilities and services buildings, workshop, storage, parking and other facilities for operations staff.

Substations

Substation locations have been chosen to minimise access distance and electrical losses, and to reduce their visibility from surrounding public viewpoints (see ***Figure 2***). Three potential locations have been identified for the Substations, which are at a minimum distance of 2 km from any nearby residences. The Substations will occupy an area approximately 220 m by 160 m or 3.52 ha. The potential locations assessed for the Substations have considered the provision for a 20 m APZ surrounding the infrastructure and a 3 m high security fence.

Transmission Lines

A combination of overhead and underground transmission lines and control cables will be used to connect the electrical infrastructure within the wind farm to the electrical network. Overhead transmission lines are up to 50 m in height. The Project is working closely with landowners to ensure impacts of overhead transmission lines are mitigated where possible. ***Images 7 and 8*** show the typical overhead transmission line configurations which could be constructed for the Project.

Permanent Meteorological Masts

Approximately six Permanent Meteorological Masts, up to hub height of the WTGs, will be installed on-site. The Permanent Meteorological Masts would be of a guyed, narrow lattice or tubular steel design with concrete footings of approximately 1 m2 for the mast and guy wires. Guy wires may extend beyond 100 m from the base of the Meteorological Mast. ***Image 9*** shows both typical Meteorological Masts designs. Locations for these masts are yet to be determined and will be influenced by the final WTG selection.

Internal Roads

Internal roads 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, Electrical Compounds, and other permanent and temporary facilities. Internal roads have been planned to follow existing farm tracks where practicable (see ***Image 10***) and have an approximate pavement width of 6 m, in addition to an adjacent drain and cut and fill batters. All internal roads will require a full or partial upgrade to accommodate the construction traffic loads, as well as for maintenance purposes during operation. The indicative internal road network is approximately 100 km in length.

Temporary Facilities

Temporary facilities will consist of construction compounds, on-site crushing and batching plants, temporary roads, stockpiles, storage areas and laydown areas if required. All temporary facility sites will be rehabilitated once they are no longer required in accordance with detailed measures to be defined within the Project BMP.

3.0 Project Overview

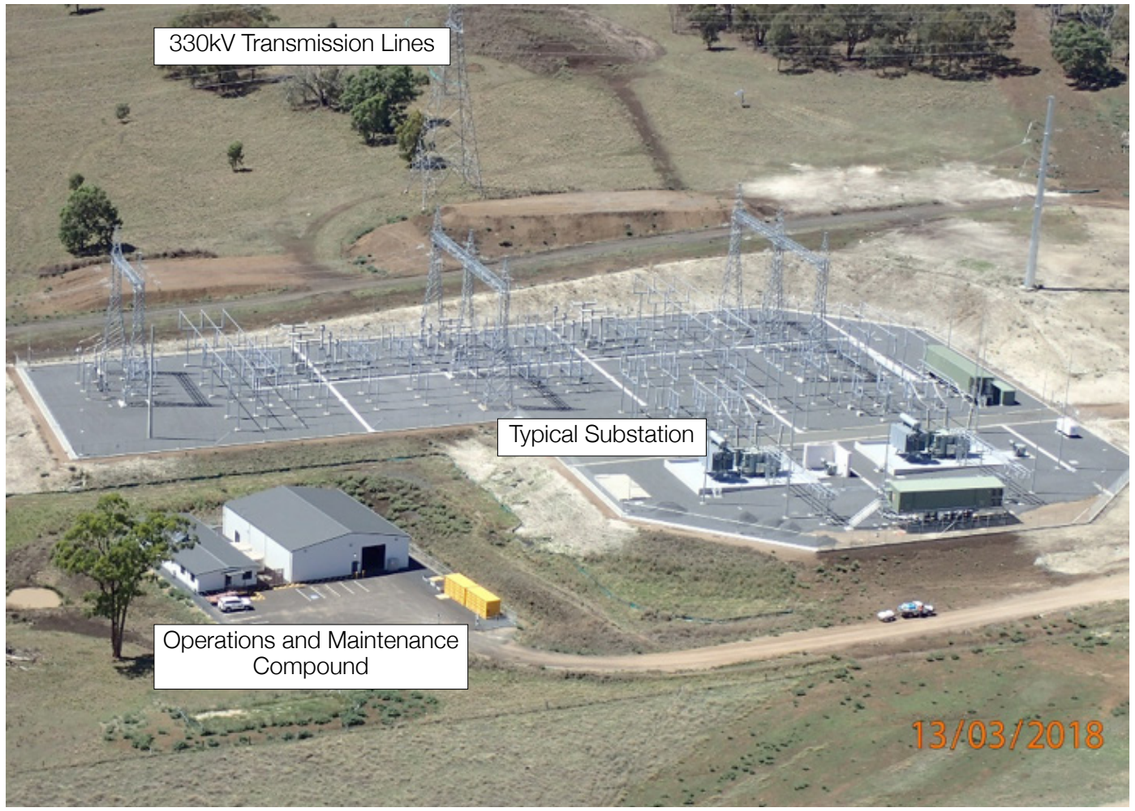


Image 5. Indicative appearance of Associated Infrastructure (Image Source: CWP Renewables)

Image 6. Typical Operations and Maintenance Compound (Image Source: CWP Renewables)

Image 7. Typical Overhead 33kV Transmission Line
(Image Source: CWP Renewables)

Image 8. Typical Overhead 330kV Transmission Line
(Image Source: CWP Renewables)

Image 9. Typical Wind Monitoring Masts
(Image Source: CWP Renewables)

Image 10. Typical Farm Road
(Image Source: MLA, 2012)

4.0 Community Consultation

4.1 Community Consultation

Community consultation was undertaken in the early stages of the Project to establish landscape values, key landscape features, important viewpoints and the community's perception of the Project. It is important to note that whilst taken into consideration when undertaking the Visual Baseline Study, the landscape values of the community are considered to be subjective.

4.1.1 Community Consultation Process

The survey was distributed throughout October and November 2018. During this time it was made available on the project website, two e-newsletters were sent to 146 web page subscribers and hardcopies were sent to all dwellings within 8 kilometres of the Site and along the transport route. The format was a simple questionnaire (refer to ***Appendix F***) to seek community input which assisted in the development of the Landscape Baseline Study. There were fifteen (15) online and nine (9) hard copies submissions received.

The Bulletin suggests community members rate the scenic quality of the landscape character as low, medium or high. However, in the context of a proposed development this is a complex process and it is likely that the results would be highly subjective. It is best practice to utilise a objective frame of reference (Refer to Scenic Quality Rating - ***Section 5.4***) which can be applied by professionals. This process can be undertaken whilst also taking into account (but not being driven by) values identified by the community.

4.2 Community Landscape Values

Landscape values are highly subjective and can differ depending on location, local context and place attachment. As landscape values and place attachment are subjective, a *Community Survey of Landscape Values* was prepared by Moir Landscape Architecture to assist in identifying key landscape values.

Based on the information received from the Community Survey, the most highly valued aspects of the local community were ranked by the community to be farming (26%) and views (32%) (see ***Figure 3***). Local rivers and creeks, farmland and rolling hills, rocky hills and outcrops were considered hold the most scenic value (see ***Figure 4***).

What do you value most about the local area?

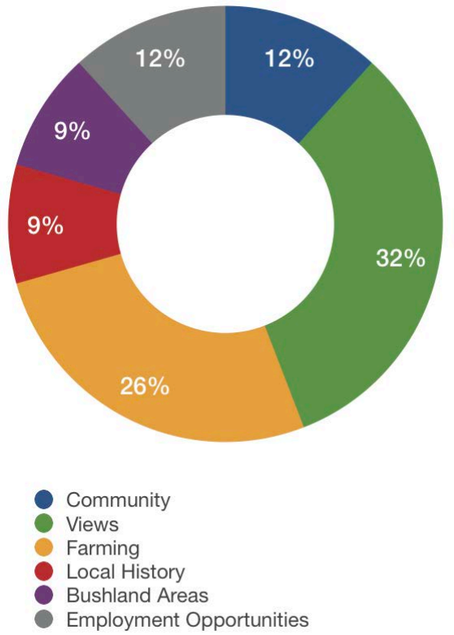


Figure 3: ***Community Values***

What landscape features do you think have the most scenic value in the local area?

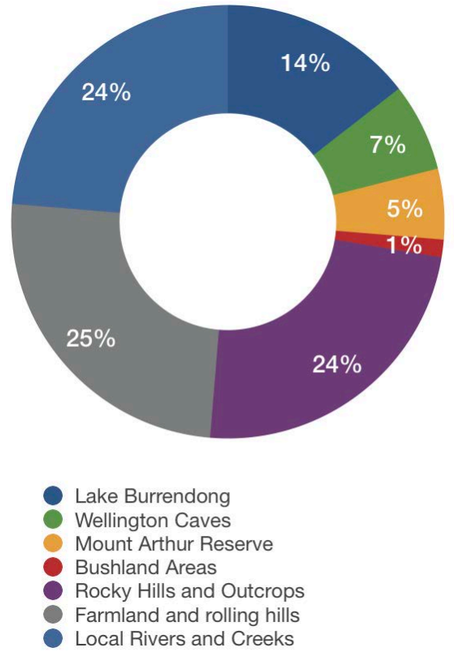


Figure 4: ***Landscape Features & Scenic Values***

Respondents were asked to list what views or landscape characteristics in the region and local were of importance to them. A number of respondents listed uninterrupted views, grazing land, rolling hills, valleys, native vegetation and Lake Burrendong to be of high level of importance to them. These have been listed in ***Table F1*** in ***Appendix F***.

The key features and characteristics identified throughout the community consultation assisted in formulating Landscape Character Units.

4.0 Community Consultation

4.3 Community Perception

Understanding of the Community Perception towards the proposed development is an important element of the Landscape and Visual Impact Assessment.

Of the 24 responses, there was general support for renewable energy investment in the region (43%), however the majority (73%) of those surveyed believed there would be a negative impact on the character of the local landscape.

A CSIRO study *Exploring community acceptance of rural wind farms in Australia* provides a snapshot of community acceptance levels regarding Australian wind farms from a variety of stakeholder perspectives. It found levels of acceptance among the public are highly subjective and can differ depending on location, local context and place attachment.

Do you support renewable energy investment in your region?

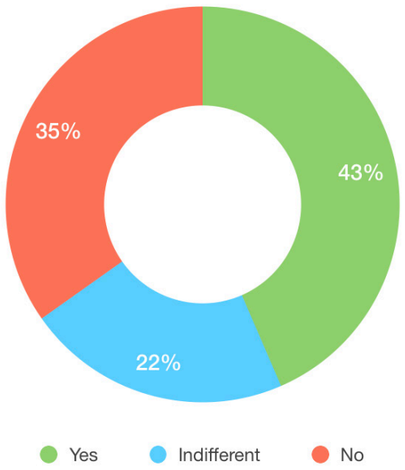


Figure 5: ***Support for renewable energy***

What impact do you think the Uungula Wind Farm would have on the character of the local landscape?

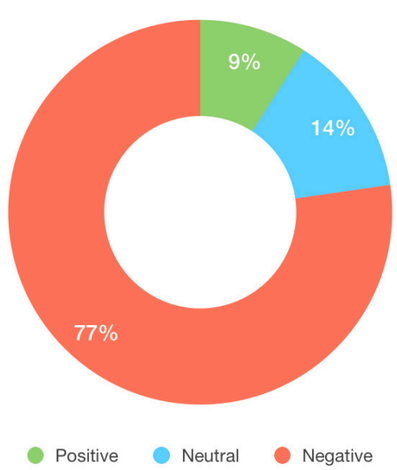


Figure 6: ***Impact on character of local landscape***

5.0 Visual Baseline Study

5.1 Visual Baseline Study

In accordance with the Bulletin, a Visual Baseline Study must be undertaken prior to any visual analysis. The purpose of the visual baseline study is to establish the existing landscape and visual conditions. The study method for undertaking the visual baseline study has been established using *Appendix 1* of the Bulletin where relevant and in conjunction with previous experience on large scale wind energy projects. The following provides an overview of the methodology used to establish a quantitative approach to defining and assessing the landscape character .

1. Landscape Character & Key Landscape Features (Refer to Section 5.2)

Given the size and prominence of wind turbines, the crux of the issue in respect to the landscape character is the extent to which a wind turbine development may impact on the existing character of the landscape and its features (NSW DOPI, 2010). ***Section 5.2.2*** outlines the key features of the region as identified through the community consultation and landscape character assessment.

3. Identification of Landscape Values (Refer to Section 4.0):

This involves the identification of landscape values based on community and stakeholder consultation and research. The results of Community Consultation are outlined in **Section 4.0** of this LVIA. It is important to reiterate the landscape values identified by the community are subjective and do not solely influence the landscape baseline study. The landscape values and key features identified by the local community have been considered when classifying Landscape Character Units, identifying key landscape features and viewpoints.

4. Landscape Character Unit Classification (Refer to Section 5.3)

Due to the large scale of the Site, Landscape Character Units (referred to as *Landscape Setting Units* in the Bulletin) have been identified for the visual catchment. Landscape Character Units have been classified for the purpose of assessing the landscape.

5. Scenic Quality Classes (Refer to Section 5.4)

Scenic Quality Classes have been applied to each Landscape Character Unit. Scenic quality refers to the relative scenic or aesthetic value of the landscape based on the relative presence or absence of key landscape features known to be associated with community perceptions of high, moderate or low scenic quality. It is both a subjective and complex process undertaken by experts in visual impact assessment, taking into account community values identified in early community consultation.

Table 4 in Section 5.4 includes an overview of the quantitative process through which scenic quality classes are rated.

5.2 Existing Landscape Character

5.2.1 Landscape Character

Generally one of the first steps in carrying out a Landscape and Visual Impact Assessment is to identify and map the landscape character of the surrounding area. The following section of the LVIA describes the regional landscape character.

Landform

The study area is located within the upper slopes subregion of the South Western Slopes Bio-region, a large area of foothills and ranges comprising the western fall of the Great Dividing Range. The landscape ranges from gently undulating to undulating. Two distinct ridge lines (Dickerton Ridge and Yarragul Ridge) run in a north to south direction to the east of Wellington north of the Macquarie River.

Vegetation

Prior to European settlement, the Study Area was dominated by communities of open-forest and woodland in higher altitudes and low open-forest and low woodlands at lower altitudes. Vegetation was generally located on fertile soils, however vegetation on fertile land has been extensively cleared for agricultural use. This has resulted in a considerable shift in the character of the landscape over time.

Gentle slopes have been cleared to increase grazing areas, however steeper, rugged ridges and ranges such as the Dickerton Ridge and Yarragul Ridge remain densely vegetated. The most intact stands are limited to State Forests such as Lake Burrendong to the south of the Site. Remnant stands of vegetation are generally located close to creeklines, river bends, along roadsides and property boundaries.

Water Bodies

Lake Burrendong is the most prominent water body of the region and was created with the construction of Burrendong Dam on the Macquarie River. When full, the Burrendong Dam contains more than a trillion litres of water and supplies local irrigators as well as towns such as Dubbo and Cobar, in the state's Central West. As of January 2020, Burrendong Dam was at 1.6% and the AGL hydroelectric station that normally uses run-off from the dam has also been taken out of action.

The Macquarie River is one of the main inland rivers of NSW and runs south east past Dubbo and through Wellington valley before reaching Lake Burrendong. The Macquarie River and associated tributaries form the main drainage system of the region.

The Cudgegong River runs into Lake Burrendong from the north east. A number of smaller tributaries of the Cudgegong River run through the landscape.

5.0 Visual Baseline Study

Land use

Agriculture is the main land use in the area and much of the land has been cleared for grazing and cropping purposes. The region is dominated by agriculture; including sheep, cattle and goat grazing, cropping for stock feed and sheep studs. The more fertile river flats associated with the Macquarie River have been intensively cropped and in areas unsuitable for mixed farming, grazing is the main land use.

Renewable Energy

Renewable energy projects have entered the landscape since 2017, including the operational Bodangora wind farm located 7 km north of the project site and the operational Beryl solar farm located 30 km east. Other approved, but yet to be constructed solar farm developments are also located in proximity to the Project, including the Wellington Solar Farm.

Image 13. Bodangora Wind Farm (Source: Infigen)

Image 11. Powerlines and farm ancillary buildings.

Image 14. Cleared foothills and vegetated hills, typical of the region.

Image 12. View from Yarrabin Road to vegetated hills. Riparian vegetation associated with Cudgegong River in the middle ground.

Image 15. Cleared land with views to vegetated hills.

5.0 Visual Baseline Study

5.2.2 Key Landscape Features

The following provides an overview of the Key Landscape Features that were identified within the visual catchment by both the community consultation and landscape character assessment. These features have been identified on ***Figure 7***.

Lake Burrendong & Burrendong State Recreation Area

Burrendong State recreation area surrounds Lake Burrendong with vegetated, elevated ridges to the south. Burrendong State Park is zoned as *E3 Environmental Management to allow for a range of low impact recreational activities and ancillary land uses in the Burrendong State Park that protect and enhance the environmental and scenic qualities of the park and the water quality of Lake Burrendong.* The land to the south of Lake Burrendong is densely vegetated and access is contained to a small number of roads.

The waters of the Macquarie and Cudgegong rivers and Meroo Creek flow into the man-made Lake Burrendong. Lake Burrendong is a popular recreation area for fishing and tourism.

Dickerton Ridge

Dickerton Range is a densely vegetated range which runs in a generally north to south direction approximately 9 kilometres east of Wellington. The Dickerton range is a feature of the landscape, providing a vegetated backdrop to the generally flat land to the east of Wellington.

Yarragal Ridge & Black Mountain

Yarragul Range is a vegetated ridgeline associated with Black Mountain which runs parallel to the Dickerton Range, between the southern extents of the Cudgeong and Macquarie River. Yarragal Ridge provides a backdrop to surrounding residences.

Macquarie River

The Macquarie river and associated riparian vegetation runs through the generally cleared landscape from Wellington to Lake Burrendong.

Cudgegong River

The Cudgegong River runs in a generally north east direction from Lake Burrendong. The river follows the valley floor and views are contained by topography.

Image 16. Lake Burrendong

Image 17. Views towards Dickerton Ridge

Image 18. Views towards Yarragal Ridge

5.0 Visual Baseline Study

5.3 Landscape Character Unit Classification

The Study Area has a similar landscape character throughout, however subtle variations in the landscapes geology, topography, land use and vegetation have been identified and the landscape has been classified into distinct and relatively homogeneous units of landscape character for the purpose of this report.

These Landscape Character Units (LCU) form the elements of the local visual context hence their quality also reflects to a degree its visual amenity. The Site has been characterised into seven Landscape Character Units for the purpose of this report as follows:

1. LCU01: Wellington *refer to Section 5.5*
2. LCU02: Bodangora refer to Section 5.6
3. LCU03: Spicers Creek *refer to Section 5.7*
4. LCU04: Wuuluman *refer to Section 5.8*
5. LCU05: Uungula *refer to Section 5.9*
6. LCU06: Burrendong *refer to Section 5.10*
7. LCU07: Cudgegong *refer to Section 5.11*

The general extent of the LCUs are shown on **Figure 7** and detailed description of each Landscape Character Unit has been included in **Sections 5.5 - 5.11** of this report.

5.4 Scenic Quality Class Ratings

Scenic quality is defined in the Bulletin as 'the relative scenic or aesthetic value of the landscape based on the relative presence or absence of key landscape features known to be associated with community perceptions of high, moderate and low scenic quality'. It is noted that scenic quality is both a subjective and complex process undertaken by experts in visual impact assessment.

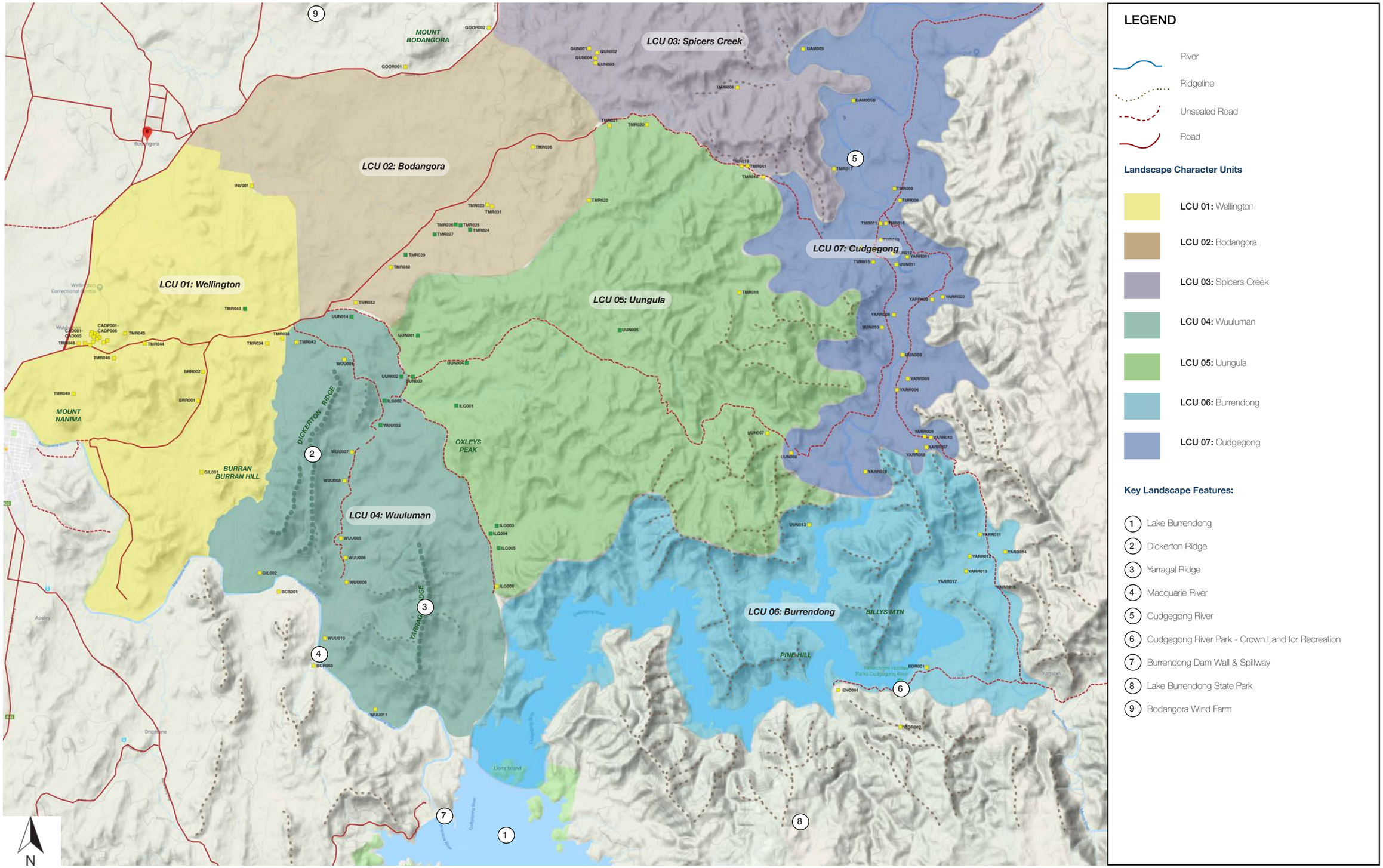
In accordance with the Bulletin, a Scenic Quality Class Rating has been applied to each Landscape Character Unit using ***Table 4*** as a frame of reference. Once quantified, a Scenic Quality Rating of low, moderate or high has been assigned to each Landscape Character Unit. The resulting Scenic Quality Rating is used to assist in defining the Visual Influence Zones in accordance with the Bulletin (***see Appendix A***).

Table 4: Scenic Quality Class Rating has been formulated by Moir Landscape Architecture as a 'frame of reference' and adapted from well established and accepted visual impact assessments throughout NSW. It is in keeping with the example frame of reference provided in the Bulletin.

SCENIC QUALITY CLASS		
Description	**LOW** ← **MODERATE** → **HIGH**	
Landform	- Flat Topography - Absence of Landscape Features - Open, broad extents of spaces	- Diversity in Topographical Range - Unique Landscape Features - Intimate spaces
Waterforms	- Absence of Water	- Presence of Water - Visually prominent lakes, reservoirs, rivers streams and swamps.
Vegetation	- Absence of vegetation - Lack of diversity - Land cleared of endemic vegetation - Low level of connection between vegetation and landscape / topography	- Abundant vegetation - High diversity - High retention of endemic vegetation. - High level of connectivity between natural landscape and landforms.
Human Influence	- High population. - High density in settlement - High presence of Infrastructure - High levels of landscape modification	- Low / dispersed population - No settlement - Absence of infrastructure - Landscape in natural state
Activity	- High levels of traffic movement - Presence of freight and passenger transport networks. - Presence of production or industry.	- Low traffic movement - Absence of freight and passenger transport. - Absence of production or industry
Rarity	- Typical landscape within a local and regional context.	- Unique combination of landscape features in a local and regional context.
Relationship with Adjoining Landscapes	- Low visible connection with adjoining landscapes. - Low variability between adjoining landscapes. - Landscape features do not contribute to amenity from adjoining landscapes.	- High visibility with adjoining landscapes. - High variability and contrast with adjoining landscapes. - Landscape features contribute significantly to amenity of adjoining landscapes.

Table 4: ***Scenic Quality Class Rating***

5.0 Visual Baseline Study



LEGEND

- River
- Ridgeline
- Unsealed Road
- Road

Landscape Character Units

- **LCU 01:** Wellington
- **LCU 02:** Bodangora
- **LCU 03:** Spicers Creek
- **LCU 04:** Wuuluman
- **LCU 05:** Uungula
- **LCU 06:** Burrendong
- **LCU 07:** Cudgegong

Key Landscape Features:

1. Lake Burrendong
2. Dickerton Ridge
3. Yarragal Ridge
4. Macquarie River
5. Cudgegong River
6. Cudgegong River Park - Crown Land for Recreation
7. Burrendong Dam Wall & Spillway
8. Lake Burrendong State Park
9. Bodangora Wind Farm

Figure 7: Existing Landscaper Character

5.0 Visual Baseline Study

5.5 LCU 01: Wellington

For the purpose of this report the Wellington LCU has been defined by the gently undulating land to the east of Wellington. The LCU is bounded to the north by Goolma Road, to the south by the Macquarie River and the east by Poggy Creek at the base of the Dickerton Range.

Land within the Wellington LCU is typical of the region. The landscape is generally cleared for agricultural practices with the exception of remnant vegetation associated with hilltops, drainage lines and homesteads. Isolated homesteads are accessed by unsealed local roads including Twelve Mile Road and Brooksfield Road. A recent rural residential subdivision is located approximately 1km to the east of Goolma Road.

Views are generally contained by local rises and vegetation and are viewed against the vegetated Dickerton Ridge. The Wellington Correctional Facility and Wellington Substation are located within this LCU, both visible from Goolma Road. A number of powerlines transverse the landscape from the Wellington Substation.

LCU 01 WELLINGTON			
	LOW	**MODERATE**	**HIGH**
Landform	√		
Waterbodies	√		
Vegetation	√		
Human Influence		√	
Activity		√	
Rarity	√		
Relationship with Adjoining Landscapes		√	
SCENIC QUALITY CLASS: LOW			

Table 5: LCU01 Scenic Quality Class Rating

Twelve Mile Road within the Wellington LCU

Grazing land within LCU

Typical agricultural land within the Wellington LCU

5.0 Visual Baseline Study

5.6 LCU 02: Bodangora

For the purpose of this report, the generally flat land to the south of Mount Bodangora has been defined as the Bodangora LCU. The LCU includes land generally associated with the Mitchell Creek between Goolma Road and the south of Twelve Mile Road.

Land within the LCU is slightly sloping towards the south east falling towards Mitchell Creek and associated drainage lines. The land is predominantly cleared for grazing purposes with some riparian vegetation associated with the creekline and sloped areas.

Access within the LCU is generally limited to Goolma Road and Twelve Mile Road which extends through the landscape providing access to farm roads and isolated homesteads. Views are generally expansive from Goolma Road and areas within the LCU due to the flat land form.

LCU 02 BODANGORA			
	LOW	**MODERATE**	**HIGH**
Landform	√		
Water Bodies	√		
Vegetation	√		
Human Influence		√	
Activity		√	
Rarity	√		
Relationship with Adjoining Landscapes		√	
SCENIC QUALITY CLASS: LOW			

Table 6: LCU02 Scenic Quality Class Rating

Typical land within the Bodangora LCU

Slightly sloping cleared land with powerlines typical of the LCU

Agricultural land with associated structures

5.0 Visual Baseline Study

5.7 LCU 03: Spicers Creek

For the purpose of this report the Spicers Creek LCU has been defined by the undulating land to the south west of Goolma. The LCU is bounded to the north Goolma Road, to the south by Twelve Mile Road and to the east by the valley associated with the Cudgegong River.

The LCU is undulating land utilised for agricultural practices with some remnant vegetation scattered through the landscape. Minor creek and drainage lines run through the LCU with associated riparian vegetation. The only public access to the LCU is along Goolma Road and Uamby Road which runs along the valley floor and provides access to a number of isolated residences. Views within the LCU are generally contained by topography.

Key features of the landscape include Spicers Creek Cemetery and the abandoned railway to the south of Goolma Road.

LCU03: SPICERS CREEK			
	LOW	MODERATE	HIGH
Landform		√	
Waterbodies	√		
Vegetation	√		
Human Influence		√	
Activity		√	
Rarity	√		
Relationship with Adjoining Landscapes		√	
SCENIC QUALITY CLASS: MODERATE			

Table 7: LCU03 Scenic Quality Class Rating

Views to vegetated hills typical of the LCU

Views to distant ranges from elevated position within Spicers Creek LCU

Scattered vegetation

5.0 Visual Baseline Study

5.8 LCU 04: Wuuluman

For the purpose of this report the Wuuluman LCU is defined by the land associated with Dickerton Ridge, Yarragul Ridge and their foothills. The LCU is bounded to the south by the Macquarie River and Lake Burrendong, to the east by Poggy Creek and to the west by Illgingerry Creek. Dickerton Ridge and Yarragul Ridge are steep vegetated ridges, which are visible from a large percentage of the site creating a valley and containing views along Wuuluman Road.

The LCU is generally uninhabited with the exception of isolated homesteads situated within the valley. Access within the LCU is limited to The Wuuluman Road, and Illgingerry Road which follow the valley floor in the general direction of Wuuluman Creek and Illgingerry Creek, respectively. Views from these roads and homesteads within the LCU are generally contained by the vegetated ridges.

LCU04: WUULUMAN	LOW	MODERATE	HIGH
Landform			√
Waterbodies		√	
Vegetation		√	
Human Influence			√
Activity			√
Rarity		√	
Relationship with Adjoining Landscapes		√	
SCENIC QUALITY CLASS: MODERATE			

Table 8: LCU04 Scenic Quality Class Rating

View from Wuuluman Road looking towards the Yarragul Range with Black Mountain Visible

Views to vegetated hills typical of the LCU

Views along the valley floor associated with Wuuluman LCU

5.0 Visual Baseline Study

5.9 LCU 05: Uungula

For the purpose of this report the *Uungula Landscape Character Unit* is characterised by the generally uninhabited undulating land to the north of Lake Burrendong. The LCU is bounded to the west by Illgingerry Road, to the south by Lake Burrendong and to the east by the valley associated with the Cudgegong River. Within the LCU, Uungula Creek runs along the valley floor in a generally north west direction from Cudgegong River.

Land in this area is predominantly utilised for grazing and as a result is mostly cleared with the exception of some scattered vegetation.

The LCU is generally uninhabited with the exception of isolated homesteads accessed via Uungula Road an Guroba Road.

LCU05: UUNGULA	LOW	MODERATE	HIGH
Landform		√	
Waterbodies	√		
Vegetation		√	
Human Influence		√	
Activity		√	
Rarity	√		
Relationship with Adjoining Landscapes	√		
SCENIC QUALITY CLASS: MODERATE			

Table 9: LCU05 Scenic Quality Class Rating

Typical farm road within the Uungula LCU

Undulating topography surrounding Uungula Road containing views

Grazing land and moderately vegetated hills typical of the LCU

5.0 Visual Baseline Study

5.10 LCU 06: Burrendong

For the purpose of this report the Burrendong LCU is defined by Lake Burrendong, associated State Recreation Areas and vegetated ranges to the south of the Cudgegong River. The LCU is bounded by Tara Road to the south west and defined to the east by the vegetated ridges visible from the Lake.

Lake Burrendong State Park is utilised for recreation activities including fishing, boating, bush walking, camping, picnics. The Lake is valued for its attractive setting with expansive views over the lake towards vegetated ranges. Two Caravan Parks are located on the lake edge, Cudgegong River Park is accessed via Yarrabin Road to the east and Burrendong Caravan Park accessed via Burrendong Way from the west.

Some existing infrastructure including the Burrendong Dam Wall, power lines and state water facility building are located on the western edge of the Lake.

LCU06: BURRENDONG	LOW	MODERATE	HIGH
Landform			√
Waterbodies			√
Vegetation		√	
Human Influence		√	
Activity		√	
Rarity			√
Relationship with Adjoining Landscapes		√	
SCENIC QUALITY CLASS: MODERATE			

Table 10: LCU06 Scenic Quality Class Rating

View across floodplain to vegetated hills

Lake Burrendong Dam Wall

Spillway

Views across Lake Burrendong to Billys Mountain

5.0 Visual Baseline Study

5.11 LCU 07: Cudgegong

For the purpose of this report the Cudgegong LCU includes the generally uninhabited land to the north of Lake Burrendong associated with the Cudgegong River. The Cudgegong River corridor consists of a long valley floor running in a generally north direction from Lake Burrendong.

Land in this area is generally uninhabited with the exception of a small number of homesteads associated with the agricultural land use along the valley floor. The LCU is accessible by two local farm roads, the Guroba Road which is accessed via Uungula Road on the western side of the Cudgegong River and the Yarrabin Road which runs along the eastern side of the river. Both roads connect with Twelve Mile Road to the north. The Cudegong River forms the boundary of the LGA's of Dubbo Regional Council (to the west) and Mid-Western Regional Council (to the east).

Views are generally contained by undulating topography either side of the valley floor.

LCU07: CUDGEGONG			
	LOW	**MODERATE**	**HIGH**
Landform		√	
Waterbodies		√	
Vegetation		√	
Human Influence		√	
Activity		√	
Rarity		√	
Relationship with Adjoining Landscapes	√		
SCENIC QUALITY CLASS: MODERATE			

Table 11: LCU07 Scenic Quality Class Rating

Yarrabin Road

Cleared land with views to vegetated hills.

Riparian vegetation associated with Cudgegong River

View from Yarrabin Road to vegetated hills. Riparian vegetation associated with Cudgegong River in the middle ground.

6.0 Visual Catchment

6.1 Defining the Visual Catchment

An initial visibility assessment was undertaken utilising the results of the Preliminary Assessment Tools and Zone of Visual Influence mapping to define the theoretical areas from which the proposed wind farm would be visible (also known as the 'Visual Catchment'). A quantitative criteria was developed to facilitate an objective assessment of the potential visibility provide a basis for further assessment to be undertaken.

6.2 Preliminary Assessment Tools

Preliminary assessment tools have been developed in the Bulletin to provide an early indication of where turbines require careful consideration because of potential visual impacts. The tools apply to both dwellings and key public viewpoints in the study area. The tools provide an early indication of where placement of turbines will require further assessment and justification, and where consultation with potentially affected landowners needs to be focused – including discussions for landholder agreements.

6.2.1 Visual Magnitude

The Visual Magnitude Threshold is based on the height of the proposed wind turbines to the tip of the blade and distance from dwellings or key public viewpoints as shown in ***Figure 8*** (based on a worst case scenario of 250m high turbine as selected for the Uungula Wind Farm). For the purpose of the Preliminary Assessment, the Visual Magnitude thresholds are based on a 2D assessment of the Project alone. Further assessment may indicate factors such as topography, relative distance and existing vegetation may minimise or eliminate the impacts of the project from residences

6.2.2 Visual Magnitude Results

When applied to the Uungula Wind Farm, *nine (9) non-involved landowner dwellings* (and one derelict house-ILG006) were identified within 3350 metres of a proposed WTG. These residences are shown on ***Figure B1*** and listed in ***Table B1*** in ***Appendix B***. ***Table B2*** in ***Appendix B*** lists the *six (6) non-involved landowner dwellings* identified between 3350 - 5000 metres of the nearest WTG.

In accordance with the Bulletin, further assessment has been undertaken for each of these dwellings (refer to ***Appendix G***).

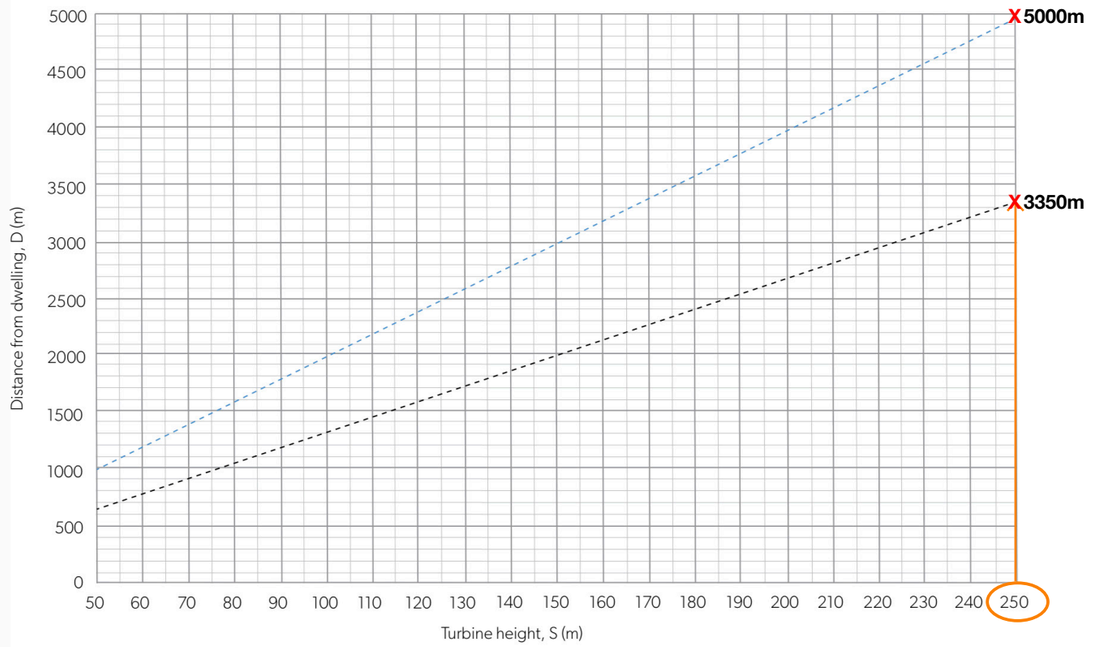


Figure 8: Visual Magnitude thresholds for visual assessment

(Source: Visual Assessment Bulletin)

6.0 Visual Catchment

6.2.3 Multiple Wind Turbine Tool

The Multiple Wind Turbine Tool provides a preliminary indication of potential cumulative impacts arising from the proposed wind energy project. To establish whether the degree to which dwellings or key public viewpoints may be impacted by multiple wind turbines, the proponent must map into six sectors of 60° any proposed turbines, and any existing or approved turbines within eight kilometres of each dwelling or key public viewpoint. ***Figure 9*** below provides examples of where a dwelling or key public viewpoint may have views to turbines in multiple 60° sectors.

Table B3 and ***Figure B2*** (refer to ***Appendix B***) identify residences which had multiple sectors of WTGs visible based on a 2D assessment of both Uungula Wind Farm and the nearby constructed Bodangora Wind Farm.

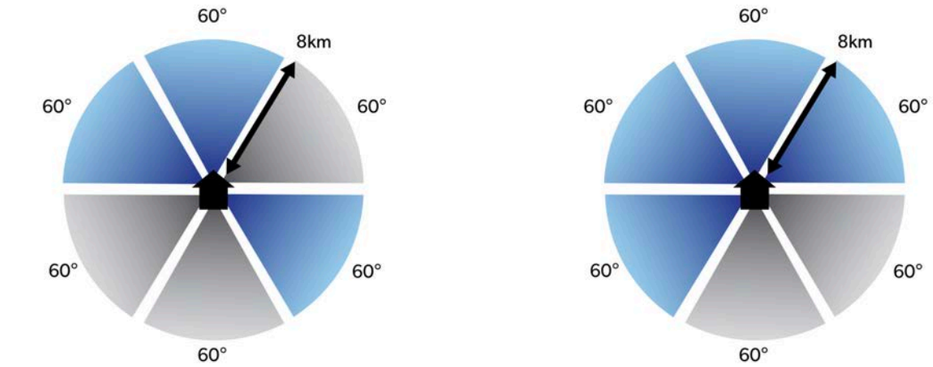


Figure 9 ***Preliminary Assessment Tool: Multiple Wind Turbines*** ***(Source: Visual Assessment Bulletin)***

6.2.4 Multiple Wind Turbine Tool Results

The Bulletin recommends further assessment to Rural Dwellings (Level 2 Sensitivity) identified as having the potential to view more than two (2) 60º sectors (180º) when using the Multiple Effect Tool.

A 2D assessment using the Multiple Wind Turbine Tool found no non-involved rural dwellings with the potential to view WTGs associated with the Uungula Wind Farm in more than two (2) 60º sectors (refer to ***Figure B2*** and ***Table B3*** in ***Appendix B***).

One non-involved dwelling (TMR022) was identified as having potential to view turbines from both the proposed Uungula Wind Farm and existing Bodangora wind turbines in up to three 60º sectors. Further assessment of this residence indicated topography screens views to the existing Bodangora Wind Farm resulting in an acceptable level of potential visibility.

6.3 Zone of Visual Influence

The Zone of Visual Influence (ZVI) represents the area over which a development can theoretically be seen, and is based on a Digital Terrain Model (DTM). The ZVI usually presents a bare ground scenario - ie. A landscape without screening, structures or vegetation, and is usually presented on a base map. It is also referred to as a zone of theoretical visibility (*The Landscape Institute and the institute of Environmental Management and Assessment, 2002*).

The ZVI identifies the areas of surrounding land from which the proposed Wind Farm may be partially or completely visible. Three ZVIs have been prepared to assess the Uungula Wind Farm. The ZVI based on blade tip height of 250 metres has been used to assess the potential visibility of the wind farm as a worst case scenario (refer to ***Figure 10***). A ZVI illustrating the potential visibility of the Project based on the hub height of 165m is provided in ***Appendix I*** and a Cumulative ZVI which includes the potential visibility of the existing Bodangora Wind Farm (see ***Section 9.0***).

Although it is possible for the development to be visible from further than 10km away, it is generally accepted that beyond 10km visibility is greatly diminished. The ZVI has been assessed to approximately 10km from the project. The ZVI has been determined through the use of digital topographic information and 3D modelling software at a height of 2m to represent a worst case scenario in accordance with the *Scottish Natural Heritage Guidelines*.

As accurate information on the height and coverage of vegetation and buildings is unavailable, it is important to note the ZVI is based solely on topographic information. Therefore this form of mapping should be acknowledged as representing the worst case scenario. In reality the zone of visibility of the Uungula Wind Farm is far less than that shown in the following ZVI figures.

The ZVI is a desktop tool intended to make the fieldwork more efficient by clearly excluding areas that are screened by topography. Considerable field assessment is then undertaken predominantly within the areas where potential for impact exists.

6.0 Visual Catchment

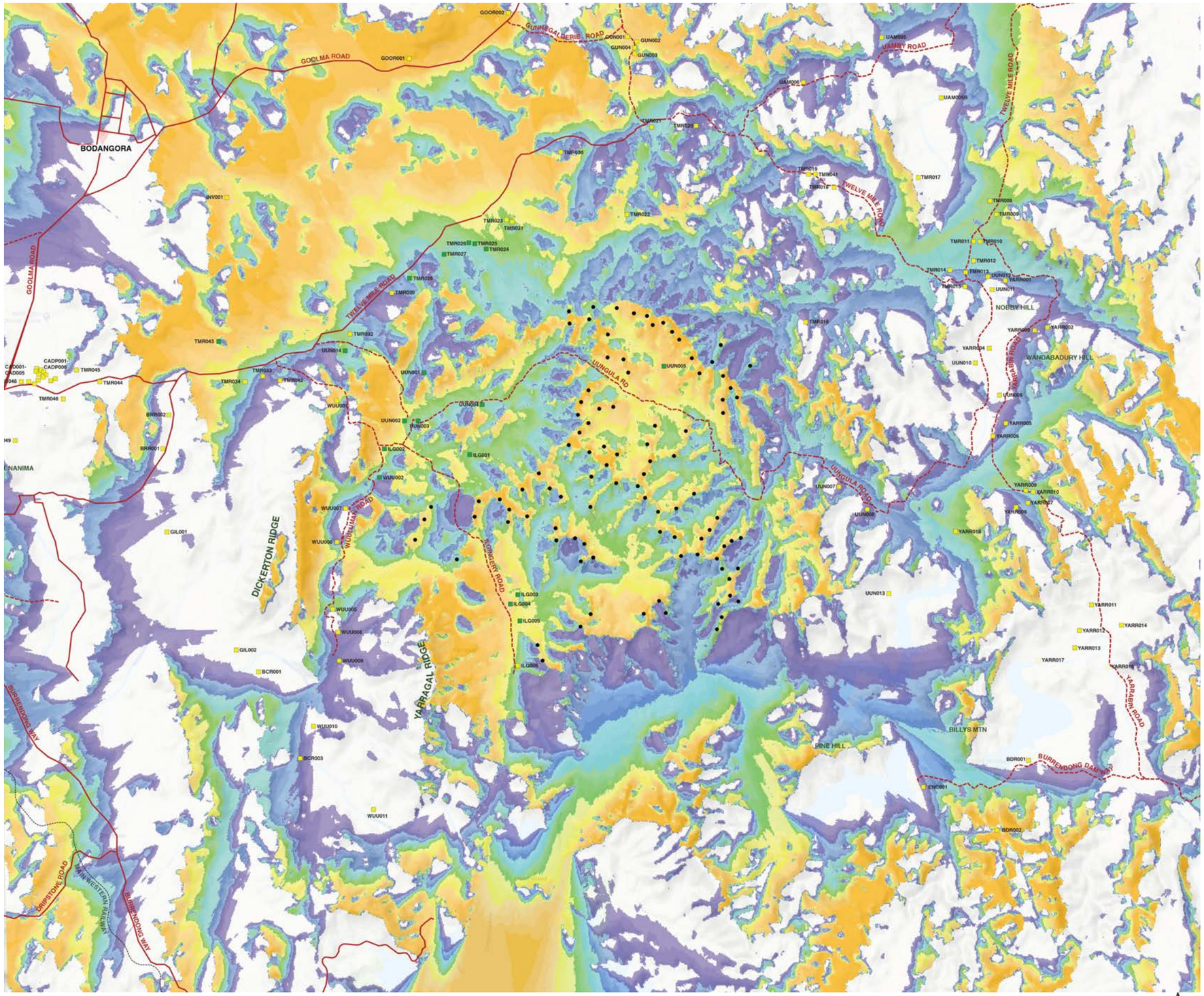


Figure 10: ***Zone of Visual Influence (Based on blade tip of WTG 250m)***

6.0 Visual Catchment

6.4 Zone of Visual Influence Overview

The Zone of Visual Influence in ***Figure 10*** illustrates the worst case turbine visibility of the proposed Uungula Wind Farm based on topography alone. Due the elevated locations of the proposed wind turbines and the blade tip height of 250m above ground level the Zone of Visual Influence depicts a large percentage of land surrounding the proposed development from which the Project would theoretically be visible.

The highest level of visibility is likely to be from residences within close proximity to the proposal and those sited on high elevations. Residences nearest the proposal include those on Illgingerry Road and Uungula Road, which run through the centre of the proposal.

Areas from which the proposal would be viewed in its entirety are limited. A number of residents located elevated land to the north of the proposal associated with Goolma Road and Gunnegalderie Road indicate high numbers of potentially visible WTGs.

The undulating topography that characterises the region results in large areas from which views of the proposed wind turbines would be screened by topography. These areas include land to the west of the proposal associated with Brookfield Road, Gilgoan Road, Wuuluman Road and the west end of Twelve Mile Road, obstructed by the rise in topography of Dickerton Ridge and Yarragal Range.

Residences to the east of the proposal are generally located within a valley associated with Cudgegong River including Twelve Mile Road and Yarrabin Road, with topography screening views.

Following the development of the ZVI using a digital terrain model, detailed site investigations (in the form of viewpoint assessments) were undertaken to ground truth the findings and define a visual catchment for the proposal (see ***Section 7.0***).

7.0 Viewpoint Analysis

7.1 Viewpoint Analysis

7.1.1 Viewpoint Selection Process

Viewpoints have been carefully selected to be representative of the range of views within the Study Area. In accordance with the Bulletin *'all key public viewpoints and individual dwellings within the 'visual catchment' should be identified and assessed'.*

The selection of viewpoints is generally informed by the topographical maps, field work observations and other relevant influences such as access, residences, landscape character and the popularity of vantage points. Viewpoints are selected to illustrate a combination of the following;

- 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), and
- sequential views along specific routes.

It is important to note that viewpoints for this LVIA study have been taken predominantly accessible public land (typically walking tracks, roads and lookouts) which were identified as having a potentially high visual impact through the desktop review process. Some viewpoints were recorded from private property with consent from landowners. Selected viewpoint assessment locations are shown on ***Figure 11***.

7.2 Viewpoint Analysis Methodology

Once the viewpoints had been selected, panoramic photographs were taken in accordance with the standards outlined in the *Scottish Natural Heritage Visual Representation of Wind Farms Guidance Version 2.2*.

Photographs used for viewpoints were taken on a level tripod at a height of 150cm (to represent eye level). Photographs were taken with a Canon EOS 5D Mark III Full Frame digital SLR through a 50mm fixed focal lens which closely represents the central field of vision of the human eye.

The visual impact of the viewpoint was then assessed both on site and with the topographic and aerial information to ensure accuracy. The findings of each viewpoint analysis have been quantified and are summarised in ***Appendix C*** of this report.

A total of *46 viewpoints* were taken during the field work process (refer to ***Appendix C***). The locations of the viewpoints have been identified in **Figure 11** and the general viewing direction of each viewpoint is identified on the map on each viewpoint. The viewpoints which have been included represent the areas from where the development would appear most prominent, either based on the degree of exposure or the number of people likely to be affected. For each viewpoint, the potential visual impact was analysed through the use of a combination of the 3D terrain modelling, topographic maps and on site analysis.

Visual Influence Zones have been established from the project area from dwellings and key viewpoints. This establishes the relative landscape significance against which the potential impacts of wind turbines may be assessed. The viewpoint assessments provide a description of the existing visual landscape. The *Visibility Distance Zone*, *Viewer Sensitivity Level* and *Scenic Quality Class* of each viewpoint have been assessed which, when combined, result in an overall *Visual Influence Zone* (see ***Table 12*** and refer to tables in ***Appendix A***). An evaluation using the corresponding *visual performance objectives* (Table 2 of the Visual Assessment Bulletin) has been assessed for each viewpoint.

VIEWER SENSITIVITY LEVEL	Viewers have varying levels of concern for scenic quality and integrity of the landscapes they see. **Refer to Table A1 in Appendix A.**
+	
VISIBILITY DISTANCE ZONES	Nine distance zones have been established based on the relative apparent size or visual magnitude of the wind turbines and distances from the viewpoint. **Refer to Table A2 in Appendix A.**
+	
SCENIC QUALITY CLASS	Descriptive category for identifying varying levels of landscape features. **Refer to Section 5.4.**
=	
VISUAL INFLUENCE ZONE	Using the above inputs, each viewpoint is assigned a *Visual Influence Zone* (High, Moderate or Low) as generated through the matrix in **Table A4 Appendix A.** **Visual Influence Zone 1: High (VIZ1)** **Visual Influence Zone 2: Moderate (VIZ2)** **Visual Influence Zone 3: Low (VIZ3)**
↓	
VISUAL PERFORMANCE OBJECTIVES	Once the *Visual Influence Zone* is assigned, each viewpoint has been assessed against the corresponding set of *Visual Performance Objectives* which guide the proponent and consent authority by establishing objectives and levels of landscape protection for the assessment and determination of the project. **Refer to Wind Energy: Visual Assessment Bulletin (Table 2).** Section 13.0 of this LVIA provides an overview of the *Visual Performance Objectives*.

Table 12: Viewpoint Assessment Process

7.0 Viewpoint Analysis

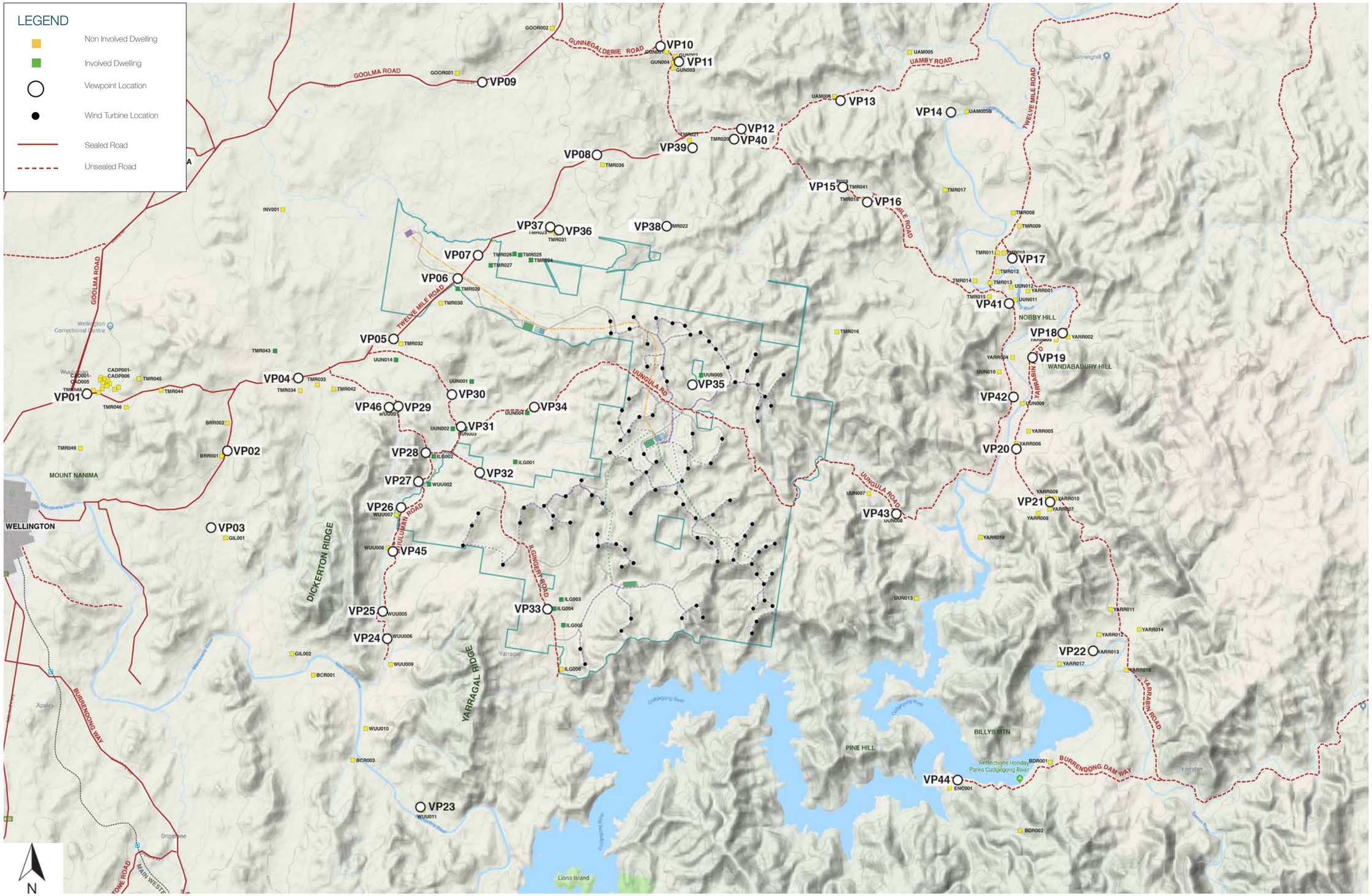


Figure 11: Viewpoint Assessment Locations

7.0 Viewpoint Analysis

7.3 Summary of Viewpoint Assessment

The 46 viewpoints assessed for the purpose of this LVIA were taken from varying distances and locations surrounding the Project. Each viewpoint was assigned a Visual Influence Zone (VIZ) (refer to the methodology in ***Section 7.2*** and ***Appendix A***). In accordance with the objectives of the Bulletin, each viewpoint was assessed against the objectives set out for the VIZ.

Visual Influence Zone 1 (VIZ1)

The assessment identified three (3) viewpoints located within VIZ1 these included VP32, VP33 and VP35, all of which are representative of nearby dwellings that are involved in the project.

Visual Influence Zone 2 (VIZ2)

The Viewpoint Analysis identified 30 viewpoints within the VIZ2, however the proposal would be screened by topography from seven (7) of these viewpoints due to topography.

Of the remaining 23 viewpoints, 18 were found to have views to the Project, however distance, existing screening factors or a small number of visible turbines mean the potential to alter the existing landscape character was low. The Project was likely to dominate existing views from six viewpoints identified within the VIZ2. These viewpoints VP28, VP29, VP31, VP34, VP46 were generally located within close proximity to the Project or had elevated views across the landscape. Further assessment of non-involved dwellings within close proximity to these viewpoints (WUU001 and WUU008) was undertaken in ***Appendix G.***

Visual Influence Zone 3 (VIZ3)

13 viewpoints were classified within VIZ3. No visual performance objective applies for landscape scenic integrity or key feature disruption.

The viewpoint analysis found that due to undulating topography of the Site there are very limited opportunities to view the Project in its entirety. One exception is the viewpoint recorded from a residence on Wuuluman Road (WUU001 - see VP46) where due to the elevated position of the residence and lack of screening factors, views towards the Project are unimpeded. Further assessment of all dwellings within up to 8kms has been undertaken in ***Appendix G***.

Photomontages have been undertaken from 18 viewpoints. In addition to the photomontages, five (5) wire frames images have been prepared to illustrate the potential visual impacts where photomontages were unable to be undertaken due to access limitations. See ***Section 8.0.***

8.0 Photomontages

8.1 Photomontage Development

8.1.1 Photomontage Selection Process

Photomontages of the proposed wind turbines within the existing context were prepared to assist in the impact assessment of the proposed Uungula Wind Farm. The photomontages are included as ***Appendix D***. A variety of indicative viewpoints have been selected for the preparation of photomontages to best illustrate the potential appearance of the proposed wind farm from varying distances and locations with differing views.

A total of ***18 viewpoints*** were selected for the production of photomontages which are generally those viewpoints determined to have the greatest potential for visual impact.

8.1.2 Photomontage Development Process

Photomontages are representations of the wind turbines that are superimposed onto a photograph of the Site. The process for generating these images involves computer generation of a wire frame perspective view of the Wind Turbines and the topography from each viewpoint. As per the requirements of the Bulletin, photomontages have been prepared in accordance with the *Scottish Natural Heritage Visual Representation of Wind Farms, Version 2.2 February 2017.* The process for photomontage development is demonstrated in ***Figure 12***.

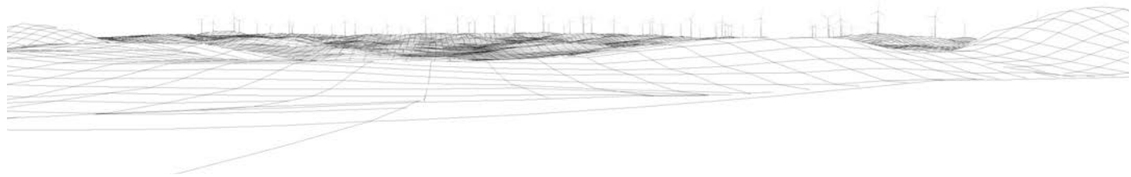
The photomontages are based on a worst case scenario of a maximum turbine height dimension of 250m with a hub height of 165m and rotor diameter of 170m, without the inclusion of the proposed mitigation methods.

8.1.3 Wire frame Images

In addition to the 18 photomontages, four (4) wire frame images (based on topography alone) have been included from residences identified as having potential views of the proposal. Refer to ***Figure 13*** and ***Table 13*** for locations.

Wire frame images are computer generated line drawings, based on a Digital Terrain Model, that indicate the three-dimensional shape of the landscape in combination with additional elements. They are a valuable tool in the wind farm LVIA process as they allow the assessor to compare the position and scale of the turbines to the existing view of a landscape. For the purpose of this LVIA, wire frame images have been utilised to illustrate the potential visibility of the Project if an existing screening element, for example vegetation or a building, were removed.

Wire frame images have been generated in accordance with the *Scottish Natural Heritage Visual Representation of Wind Farms, Version 2.2 February 2017.*



STEP 1: Location and dimensions of the wind turbines are defined in a landscape wire frame.

STEP 2: Wire frame and photo of existing landscape are overlaid and aligned to match.

STEP 3: Photomontage developed by merging wind turbines with existing landscape features.

Figure 12: Photomontage Development Process

8.1.4 Blue Sky Comparisons

In addition to generating photomontages comparing the existing and proposed views, photomontages have been developed with superimposed skies to compare different backdrops. In clear weather, the wind turbines will appear prominent contrasting against the blue sky, whereas on overcast days the wind turbines may be less noticeable with an overcast or cloudy background reducing the level of visual contrast. Cloud coverage and rainfall can impede distant views.

Although efforts were made to obtain photographs in clear weather, due to site conditions at the time of field work, some photographs were taken with a grey sky back drop. To assist in simulating a worst case scenario, a blue sky was superimposed onto selected photomontages, these comparisons have been included as ***Appendix E.***

8.0 Photomontages

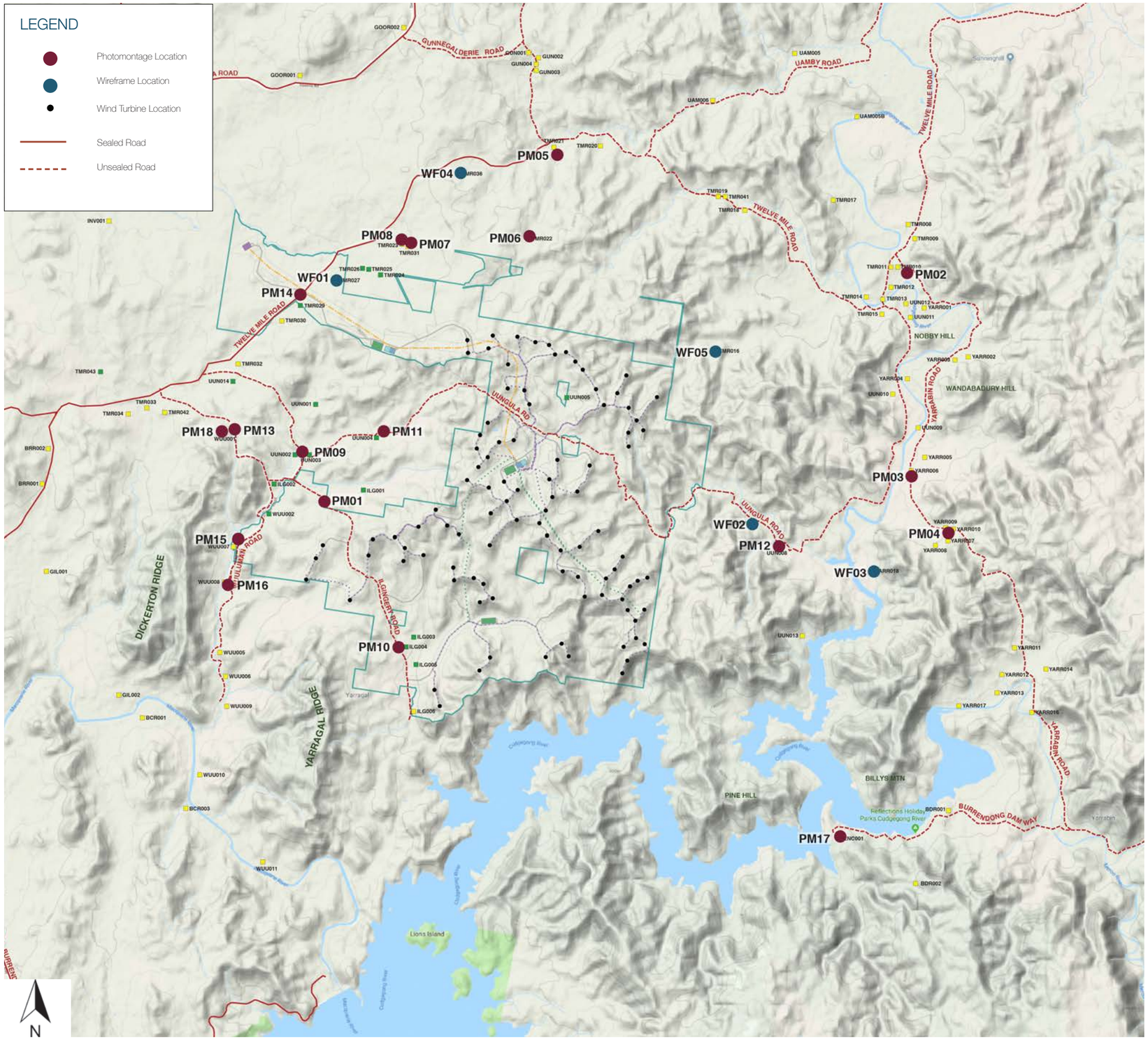


Figure 13: Photomontage and Wire frame Assessment Locations

Photomontage (PM) Locations			
ID	**Viewpoint**	**Location**	**Nearest Dwelling ID**
PM01	VP32	Ilgingery Road	ILG001
PM02	VP17	Yarrabin Road	TMR10, TMR11, TMR12
PM03	VP20	Yarrabin Road	YAR005 YAR006
PM04	VP21	Yarrabin Road	YAR007-010
PM05	VP39	Twelve Mile Road	TMR021
PM06	VP38	Twelve Mile Road	TMR022
PM07	VP36	Twelve Mile Road	TMR023
PM08	VP37	Twelve Mile Road	TMR031
PM09	VP31	Uungula Road	UUN002, UUN003
PM10	VP33	Ilgingery Road	ILG003-ILG005
PM11	VP34	Uungula Road	UUN004
PM12	VP43	Uungula Road	UUN008
PM13	VP29	Wuuluman Road	N/A
PM14	VP06	Twelve Mile Road	TMR029
PM15	VP26	Wuuluman Road	WUU007
PM16	VP45	Wuuluman Road	WUU008
PM17	VP44	Cudgegong River Park	ENC001
PM18	VP46	Wuuluman Road	WUU001
Wireframe (WF) Locations			
WF01	VP07	Twelve Mile Road	TMR027
WF02	-	Uungula Road	UUN007
WF03	-	Yarrabin Road	YARR018
WF04	-	Twelve Mile Road	TMR036
WF05	-	Twelve Mile Road	TMR016

Table 13: Photomontage & Wire frame Locations

9.0 Cumulative Visual Impacts

9.1 Cumulative Visual Impacts

Cumulative landscape and visual effects result from additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments (associated with or separate to it) or actions that occurred in the past, present or are likely to occur in the foreseeable future (Landscape Institute et al, 2008). Cumulative effects may also affect the way a landscape is experienced and can be positive or negative. Where they comprise benefits, they may be considered to form part of the mitigation measures.

The Draft Planning NSW Guidelines state that "Cumulative impacts may result from a number of activities with similar impacts interacting with the environment in a region. They may also be caused by the synergistic and antagonistic effects of different individual impacts interacting with each other and may be due to temporal or spatial characteristics of the activities' impacts."

It is important the proposed Uungula Wind Farm considers the potential cumulative effects on the immediate and broader regional context it forms part of. The proposal needs to take into account change of scale and the potential for the receiving landscape to accommodate the larger composite feature.

The review of the cumulative impact has several dimensions:

- The impact of the wind farm, when added to the combined impacts of all other existing developments and environmental characteristics of the area.
- The impact of this development in the context of the potential for development of wind energy developments in the local, regional and national context.
- The impact of developments which are ancillary to or otherwise associated with the proposed wind farm eg. the development of transmission lines.
- The potential for future development of wind farms in the region.

The Scottish Natural Heritage (2005) identifies a range of potential cumulative landscape impacts of wind farms on landscapes which include:

- Combined visibility (where two or more wind farms will be visible from one location)
- Sequential visibility (e.g. The effect of seeing two or more wind farms along a single journey e.g road or walking trail)
- The visual compatibility of different wind farms in the same vicinity
- Perceived or actual change in land use across a character type or region.
- Loss of a characteristic element (e.g. Viewing type or feature) across a character type caused by developments across that character type.

9.2 Approved Wind Farm Developments

The existing Bodangora Wind Farm includes 33 Wind Turbines located approximately 9 kilometres north west of the Uungula Wind Farm (to the north of Goolma Road). Refer to ***Section 9.3*** for a summary of the potential cumulative visual impacts.

There are a number of wind farm projects proposed and awaiting approval within the wider regional context that may commence works in the near future. Proposed wind farm projects in the area have been summarised in the table below. Information sourced from *NSW Department of Planning and Infrastructure* website and is considered correct as of January 2020.

Project	Distance (Approx.)	Size	Planning Status
Bodangora Wind Farm	**Approx. 9 km**	**33 Turbines**	**Operating**
Refer to Section 9.3 of this report for detailed assessment			
Crudine Ridge Wind Farm	**> 40 km**	**Up to 37 Turbines**	**Under Construction**
Crudine Ridge Wind Farm is a 37 turbine wind farm, with a capacity to generate up to 135 MW of electricity, plus ancillary infrastructure (including substation, grid connection, access tracks and road upgrades along the project transport route). The wind farm is in excess of 40kms from Uungula and will result in no cumulative visual impact.			
Liverpool Range Wind Farm	**> 60 km**	**Up to 267 Turbines**	**Approved**
The Liverpool Range Wind Farm, located between Coolah and Cassilis around 100km north east of Mudgee, will consist of up to 267 wind turbines. There will be no cumulative impact from Liverpool Range Wind Farm.			
Flyers Creek Wind Farm	**> 100 km**	**Up to 38 Turbines**	**Approved**
The proposed Flyers Creek wind farm is located approximately 20 km southwest of Orange (Blayney Shire) in NSW, comprising up to 38 wind turbines. Project Approval for the Flyers Creek wind farm was granted by the NSW Government Planning Assessment Commission in March 2014. Flyers Creek Wind Farm is in excess of 100 kms from Uungula Wind Farm and there will be no cumulative impact.			

Table 14: ***Nearby Wind Farms***

9.0 Cumulative Visual Impacts

9.3 Assessment of Cumulative Impact: Bodangora Wind Farm

9.3.1 Zone of Visual Influence

Due to the close proximity of the proposal to the Bodangora Wind Farm, a Cumulative Zone of Visual Influence (ZVI) figure has been prepared by Moir Landscape Architecture (refer to ***Figure 14***). The Cumulative ZVI identifies areas from which both proposals would theoretically be visible, based on topography alone.

It has been identified that the highest potential for a cumulative visual impact is likely to be experienced between the two proposed wind farms, to the north of the of Uungula Wind Farm and to the south of Bodangora Wind Farm. Goolma Road and Twelve Mile Road run through this area and although largely uninhabited, a small number of isolated residences are located within this area of rural land. The cumulative impact from these residences is likely to be determined by a number of variable influences including existing vegetation, orientation of the residence and extent of the proposal which would be visible.

The existing visual character of Goolma Road has the potential likely to be slightly altered as a combined result of the proposals. Based on the ZVI, it is identified that either the Bodangora, Uungula or both wind farms would be visible along Goolma Road. Roadside vegetation is a prominent element of Goolma Road which would significantly reduce these potential views. Travelling along Goolma the local presence of Wind Farms would be apparent, however the distance from both wind farms and speed of travel along the road would assist in reducing the potential visual impact. Views towards the Uungula Wind Farm in particular are distant.

Other areas identified by the ZVI are likely to have a negligible cumulative impact due to the distance from the wind farms. For example the ZVI indicates large areas of land to the east of Yarrabin Road, south of Lake Burrendong and south west of the proposed Uungula Site near Burrendong Way. Views from these areas are in excess of 10kms to Uungula Wind Farm and 20 kms to Bodangora Wind Farm. Land in these areas are largely uninhabited and relatively inaccessible.

9.3.2 Multiple Wind Turbine Tool

In accordance with the Bulletin, the Multiple Wind Turbine Tool (refer to ***Section 6.0*** and ***Appendix B***) was applied to both the Uungula and Bodangora Wind Farms. The Multiple Wind Turbine Tool identified 14 rural dwellings which may view both Wind Farms in two or more 60º sectors within 8kms of the Project. In accordance with the *Visual Performance Objectives*, these rural dwellings are *Level 2 viewpoints* and therefore views must be avoided within three or more sectors. Of the 14 dwellings identified, only one dwelling was identified as having the potential to view three or more 60º sectors of WTGs associated with the Uungula and Bodangora Projects (TMR022). Further assessment of this TMR022 indicates topography screens the existing Bodangora Wind Farm and there would be no cumulative visual impact.

9.0 Cumulative Visual Impacts

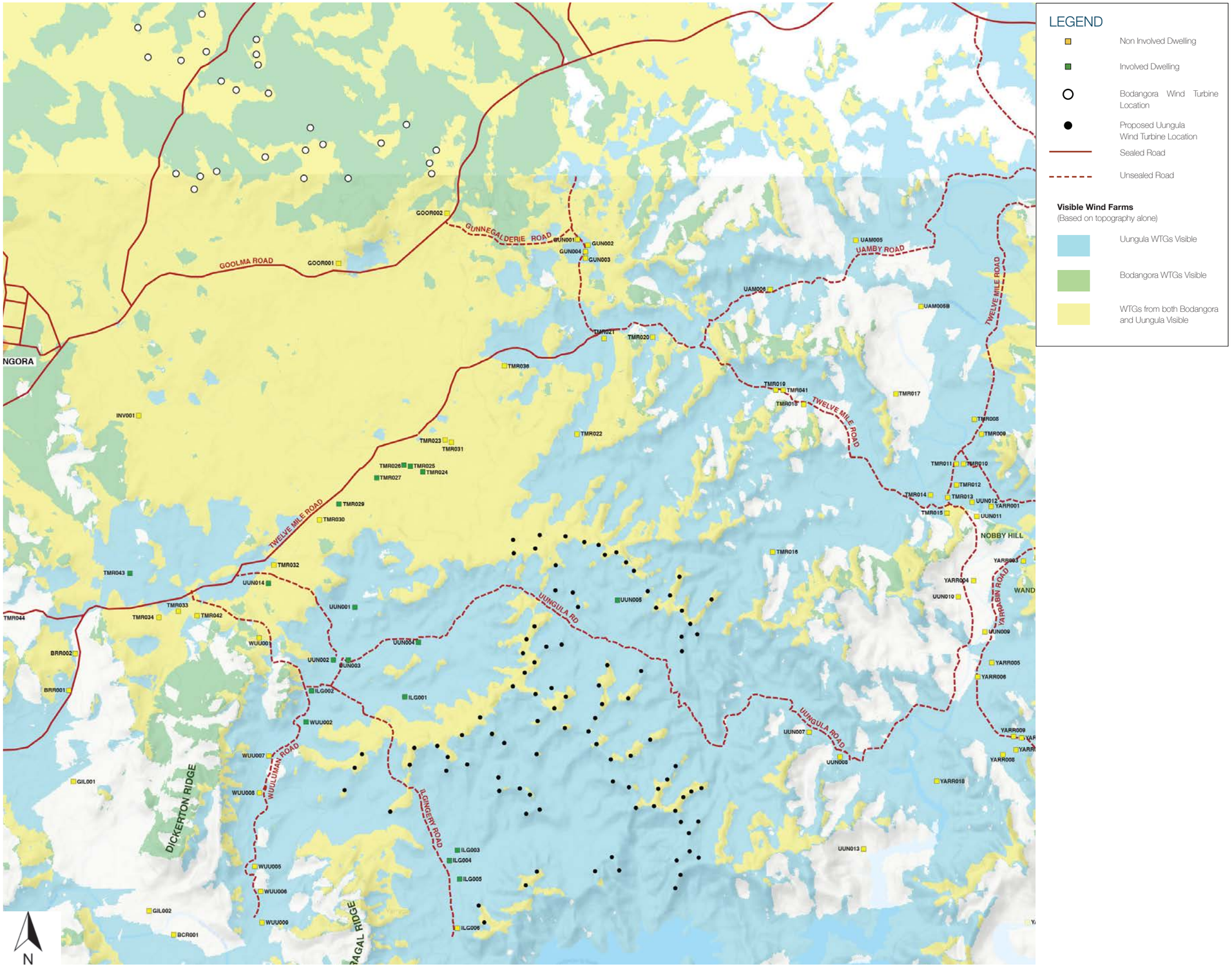


Figure 14: Cumulative Zone of Visual Influence - Bodangora and Uungula Wind Farms

9.0 Cumulative Visual Impacts

9.4 Overview of Cumulative Visual Impacts

Due to both the topography of the landscape and the distance between Uungula and the other wind farms, there is limited opportunity to view more than one proposed wind farm from a single viewpoint. The nearest proposed wind farm to Uungula Wind Farm is the existing Bodangora Wind Farm which is located within 9km north at its nearest point.

The potential cumulative visual impact must also be assessed in relation to the potential visual impact when viewed sequentially. If a number of wind farms are viewed in succession as a traveller moves through the landscape (eg. motorist travel routes or walking tracks) this may result in a change in the overall perception of the landscape character. The viewer may only see one wind farm at a time, but if each successive stretch of the road is dominated by views of a wind farm, then that can be argued to be a cumulative visual impact (EPHC, 2010).

The Uungula Wind Farm is a relatively isolated development, set back from major transport routes and views from these major routes are generally obstructed by topography and vegetation.

9.4.1 Visual Impact on the Broader Landscape Character

The existing landscape character of the region allows for optimum harvest of wind energy due to elevated topography, expanses of uninhabited land and minimal obstructions in the landscape. These characteristics are beneficial to the output of wind energy and it is inevitable that overtime this will be utilised.

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 prevail it is important to determine whether the cumulative effect of wind farms and other major infrastructure within the region would combine to become the dominant visual element, altering the perception of the general landscape character.

The region has the capability to visually accommodate the proposed Uungula Wind Farm development when assessed in combination with the other proposed developments without eroding the broad landscape character. The Uungula Wind Farm is generally obstructed from view by topography and existing vegetation from major transport routes. As the cumulative impact of the proposals in the region is low wind farms as an element would not emerge as a dominant feature to visitors of the area. It is unlikely the perceptions of the regions broad landscape character would be significantly altered as a result of the proposal.

9.5 Cumulative Impact of Infrastructure

9.5.1 Existing Local Infrastructure

Currently, the landscape character is a predominantly rural, interspersed with infrastructure associated with supplying major towns (power lines, roads etc.). Travelling along Goolma Road towards Wellington a combination of developments have altered the appearance of the rural landscape. TransGrid's Wellington Substation is a high voltage 330kV / 132kV substation located 2.4 km north east of Wellington on Goolma Road. Associated with the Wellington Substation, a number of high voltage power lines extend through the landscape servicing the region. Wellington Correctional Centre is also sited on Goolma Road approximately 5.5 km north east of Wellington along the Goolma Road. Both of these developments are partly concealed from view by screen planting.

9.5.2 Cumulative Visual Impact of Associated Infrastructure

The proposed transmission lines required for Uungula Wind Farm are visually similar to existing power line structures which are a common element throughout the study areas visual landscape. The proposed transmission lines would appear as an extension of the existing transmission line network in the region.

Due to the layout of the proposal being spread across a large area of land, the transmission lines would form only a minor element in the overall landscape furthermore there are limited opportunities to view the proposed transmission lines from publicly accessible land in conjunction with the existing transmission lines. Connection options are generally located away from major transport routes (refer to ***Figure 2***).

Ancillary structures including substations, switching stations are of a relatively small scale in the overall landscape. With mitigation measures incorporated, they and are unlikely to contribute to a cumulative visual impact.

10.0 Shadow Flicker, Blade Glint and Lighting

10.1 Shadow Flicker

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 effect will occur under circumstances where the turbine is located such that at certain times of day the sun's rays pass through the swept area of the rotating blades, potentially affecting the viewpoint. The effect is diminished by the distance of the viewpoint from the turbine. Shadowing is also influenced by increased cloud cover, and is dependent on the angle of the sun's rays (Connell Wagner, 2006).

10.1.1 Standard limits for Shadow Flicker

The Bulletin requires the impact of shadow flicker from wind turbines on non-involved residences within 2km of a proposed wind turbine should be assessed and that the shadow flicker at non-involved residences should not exceed 30 hours per year as a result of the proposed wind turbines.

Modelling of the shadow flicker was conducted using specialist industry software, assessing the largest turbine (based on a 250m maximum tip height) proposed for the project to represent the worst case impact scenario. The maximum number of annual hours at each of the nearby houses and buildings where shadow flicker may be experienced was calculated using this model (refer to ***Figure 15***).

The methodology used for the Shadow Flicker Assessment is as follows:

- A receptor height of 2 metres above ground level is generally recognised as a standard practice. The shadow flicker modelling developed for Uungula Wind Farm is based on a viewing height of 1.7 metres and therefore represents a worst case scenario.
- Determine the extent of shadows from turbines, based on a distance of 265 m x maximum blade chord (this is the accepted standard)
- Identify all existing or approved dwellings within the potential extent of shadows from proposed turbine positions.
- Consider possible impacts of shadow flicker; identifying those impacts with negligible or significant risks.
- Consider mitigation methods to minimise potential shadow flicker impacts.

It is important to note the shadow flicker modelling undertaken for Uungula Wind Farm is based on topography alone and therefore the extent of impact may be decreased by a number of variables including:

- the aspect of the residence relative to the turbine(s) (window locations, living area locations etc);
- the extent of natural or screening vegetation between the turbine(s) and the receptor;
- the existence of other screening elements (buildings, structures etc) between the turbine(s) and the receptor;
- the time of year;
- the proportion of daylight hours in which the turbines operate, and;
- the frequency of bright sunshine and cloudless skies (particularly at low elevations above the horizon).

Shadow flicker effects will be strongest closest to the wind turbines, as the shadows cast by the rotating blades will be more intense (more sharply delineated). As the distance from the wind turbines increases, the shadows cast by the rotor blades will become less distinct, reducing the impact of the flicker. This continues until, at a distance of a few kilometres, the proportion of light blocked by the wind turbine blades becomes so small that flicker is no longer discernible (Aurecon, 2011).

Image 18. Example of shadow intensity variation with distance
(Source: Aurecon, 2011)

Image 19. Example of shadow from WTG
(Source: http://www.renewableenergyworld.com)

10.0 Shadow Flicker, Blade Glint and Lighting

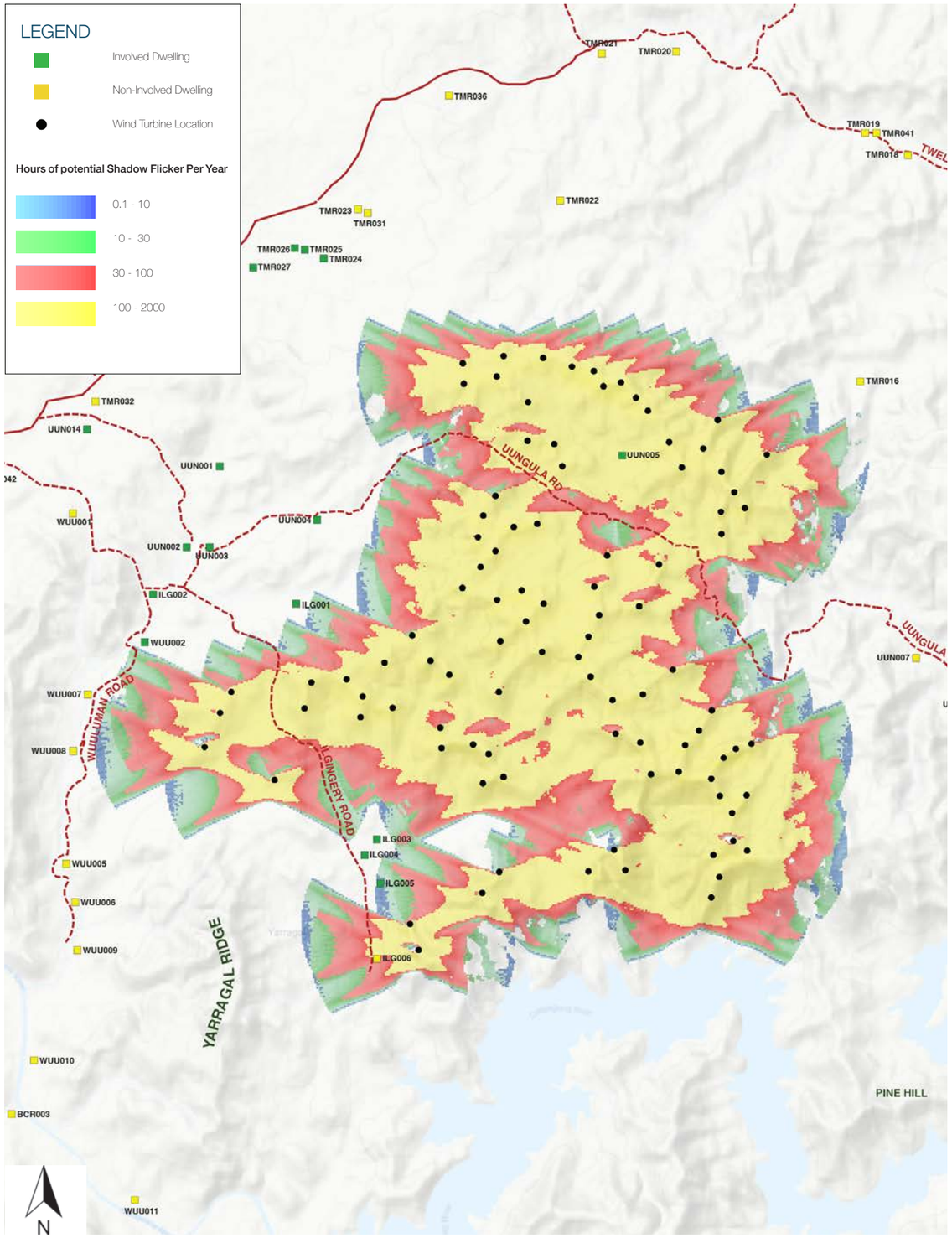


Figure 15: ***Shadow Flicker***

10.1.2 Shadow Flicker Assessment Results - Residences

Considering the size of the proposal, the shadow flicker affects caused by the proposed Uungula Wind Farm are minimal. Based on a height of 250 metres, it is likely a total of two residences (**UUN005** and **ILG005**) would potentially be affected by shadow flicker caused by the proposed wind turbines (refer to ***Figure 15***). Dwelling **ILG006** is located within the area affected by potential shadow flicker, however this is a derelict house and therefore no standard limits apply.

Dwelling **UUN005** and **ILG005** are both involved landowners. The shadow flicker assessment indicates the potential shadow flicker at ILG005 is below the maximum standard of 30 hours per year. The assessment suggests shadow flicker in excess of 100 hours per year could affect UUN005. Mitigation methods utilised for visual amenity (including screen planting) would significantly reduce the annoyance caused by shadow flicker for UUN005. ***Section 12.0*** of this report suggest practical methods which can assist in mitigating potential affects of shadow flicker on residences where required.

10.1.3 Shadow Flicker Assessment Results - Roads

Due to the isolated nature of the Study Area, there are a number of unsealed minor local roads close to the Site. The results of the shadow flicker analysis indicates shadow flicker may occur on small sections of Uungula Road and Illgingery Road. These roads have a low frequency of use and elements such as roadside vegetation would significantly reduce any potential shadow flicker along these road.

There is a negligible risk associated with distraction of motorists who experience shadow flicker. The effects of shadow flicker are similar to the phenomenon created when a vehicle in motion passes a static object eg. travelling along a tree lined road (see images 20 & 21).

Image 20 & 21. Shadows cast onto roads by trees, power poles etc have a similar effect on moving vehicles. (Source: MLA)

10.0 Shadow Flicker, Blade Glint and Lighting

10.2 Blade Glint

Blade Glint (also referred to as blade reflectivity) refers to the regular reflection off one or more rotating blades. This can be a temporary effect at any particular location, though the vast bulk of any glint occurs where the viewer is located above the altitude of the turbine hub. The occurrence of blade glint depends on a number of conditions including the orientation of the nacelle, angle of the blade, and the angle of the sun (Aurecon, 2009).

The Bulletin recommends turbine blades be finished with a low reflectivity surface treatment to ensure any actual or perceived blade glint impact is minimised.

10.3 Night Lighting Assessment

10.3.1 Aviation Hazard Lighting

The requirement of aviation hazard lighting (AHL) on wind turbines for the proposed Uungula Wind Farm is subject to the advice of the Civil Aviation Safety Authority (CASA). It is noted that the wind turbines proposed for use in the Uungula Wind Farm will possibly be up to 250m in height and CASA has indicated that "this height could be a hazard to aircraft traversing the area" and recommends "that the proponent takes this into consideration when assessing their duty of care in deciding whether or not the wind farm should be obstacle lit or otherwise marked". CASA also noted that reference is made to the fact that "aircraft are generally permitted to fly as low as 500 ft (152 m) above ground level, and certain operations are permitted to fly below this height."

Although this is to future detail, the potential CASA requirements for lighting could include:

- Two flashing red medium intensity obstacle lights should be provided per turbine where required.
- The light fixtures should be mounted sufficiently above the surface of the nacelle so that the lights are not obscured by the rotor hub, and are at a horizontal separation to ensure an unobstructed view of at least one of the lights by a pilot approaching from any direction.
- All lights on a wind farm should flash simultaneously.
- Sufficient individual wind turbines should be lit to indicate the extent of the group of turbines.
- The interval between obstacle lighted turbines should not exceed 900m, and the most prominent (highest for the terrain) turbine(s) should be lit.

As the intensity and location of proposed obstacle lights are relatively unknown at this stage, representative photomontages of the proposed obstacle lighting of Uungula Wind Farm have not been included in this report. An image has been included on the following page which provides an example of obstacle lighting at Waubra, Victoria and mitigation methods outlined in ***Section 12.0*** of this report have been provided to assist in lessening any potential visual impact resulting from night lighting.

10.0 Shadow Flicker, Blade Glint and Lighting

10.3.2 Overview of potential visual impact from Aviation Hazard Lighting

Night lighting of the wind turbines would potentially result in the alteration of the night time landscape character of the region. It has the potential to have a visual impact on receptors including motorists and residents.

Potential visual impacts associated with obstacle marking and lighting at night time have not been extensively researched or tested in New South Wales, although some site investigations have been carried out at existing wind farms in Victoria. Investigations have generally concluded that although night time lighting mounted on wind turbines may be visible for a number of kilometres from the wind farm project area, the actual intensity of the lighting appears no greater than other sources of night time lighting, including vehicle head and tail lights. Previous investigations have also suggested that replacing the more conventional incandescent lights with light emitting diodes (LED) may help to minimise the potential visual impact of the wind turbine lights (Epuron 2008).

Existing night lighting is present in the Uungula area, associated with homesteads dispersed around the Study Area. Headlights and brake lights from vehicles travelling through the area along local roads also create an intermittent source of illumination. The visual impact from night lighting in the area is unlikely to have a significant visual impact on receptors including motorists and residents in the area. If required, there is a potential for lighting to incorporate shields to minimise the visibility of lighting below the horizontal plane (Refer to ***Section 12.0*** of this report).

Image 22. Example of obstacle lighting at Waubra Wind Farm (Source: http://flickr.com/)

10.3.3 Potential Light Sources - Ancillary Infrastructure

In addition to aviation hazard lighting on wind turbines, 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 collector substations and facilities buildings is to be confirmed.

TransGrid and Essential Energy require the provision for night lighting that is not low-intensity on the switching stations for operational safety reasons. This is would only be used intermittently for operational and emergency maintenance reasons. Additionally, twenty-four hour low-intensity security night lighting or low intensity flood lighting within compounds in accordance with AS1680 would be incorporated into the design (CWP Renewables).

Proposed ancillary infrastructure has been carefully sited to minimise visibility from existing residences and publicly accessible viewpoints. It is unlikely the proposed night lighting associated with the ancillary infrastructure would create a noticeable impact on the existing night time landscape.

It is likely mitigation methods outlined in ***Section 12.0*** of this report would minimise any potential visual impact resulting from the lighting of ancillary structures.

11.0 Overview of Visual Impacts

11.1 Overview of the Visual Impact on LCUs

The following section provides an overview of the assessment of the potential visual impacts on the existing landscape character of the local area for each Landscape Character Unit (LCU) as characterised in ***Section 5.3*** of this report. An evaluation of the potential visual impacts has been undertaken using the visual performance objectives as outlined in the Bulletin). An overview of the potential visual impact has been provided for each residence in ***Appendix G.***

11.2 LCU01 Wellington (Refer to Section 5.5)

11.2.1 Visual Assessment

The Proposal is located to the east of the Wellington LCU. Land in this area is generally flat to slightly undulating, with the exception of several notable hills and ridgelines. Roads and associated residences generally follow the flat land associated with Macquarie River and its tributaries, which assists in views being screened by topography. Views from Wellington Town and associated residences would be screened by a combination of distance, vegetation and riparian vegetation associated with the Macquarie River.

Dickerton Ridge is a large, vegetated ridgeline which runs approximately six kilometres in a generally north to south direction to the west of the study site. The proposed wind farm development will be screened from the majority of residences located to the west of the study site by topography associated with the ridge.

Of the many residences located within the Wellington LCU, all are located in excess of 5 kilometres from the nearest WTG. The ZVI (based on topography alone) identified only five dwellings with potential views of wind turbines. Further assessment of these dwellings was undertaken and found the proposal would result in minimal visual impact due to vegetation surrounding the dwellings from ***TMR033***, ***TMR034*** and ***TMR042***. Distant views to the proposal would be available from ***INV001*** (in excess of 10kms) and ***TMR043*** (involved land owner). An overview of the potential visual impacts from each dwelling within the Wellington LCU has been provided in ***Table G1 Appendix G***.

11.2.2 Visual Performance Objectives

Landscape Scenic Integrity

The Proposal will not modify the visual catchment of the area identified as 'Wellington LCU'. There are only a small number of opportunities to view the Proposal in the distance from within LCU from elevated positions on local farm roads.

Key Landscape Features

The vegetated hills associated with the Dickerton Ridge form a dramatic backdrop to views across grazing land to the east. The dramatic ridge associated with Dickerton Range will remain a visually prominent feature of the landscape from land within this LCU.

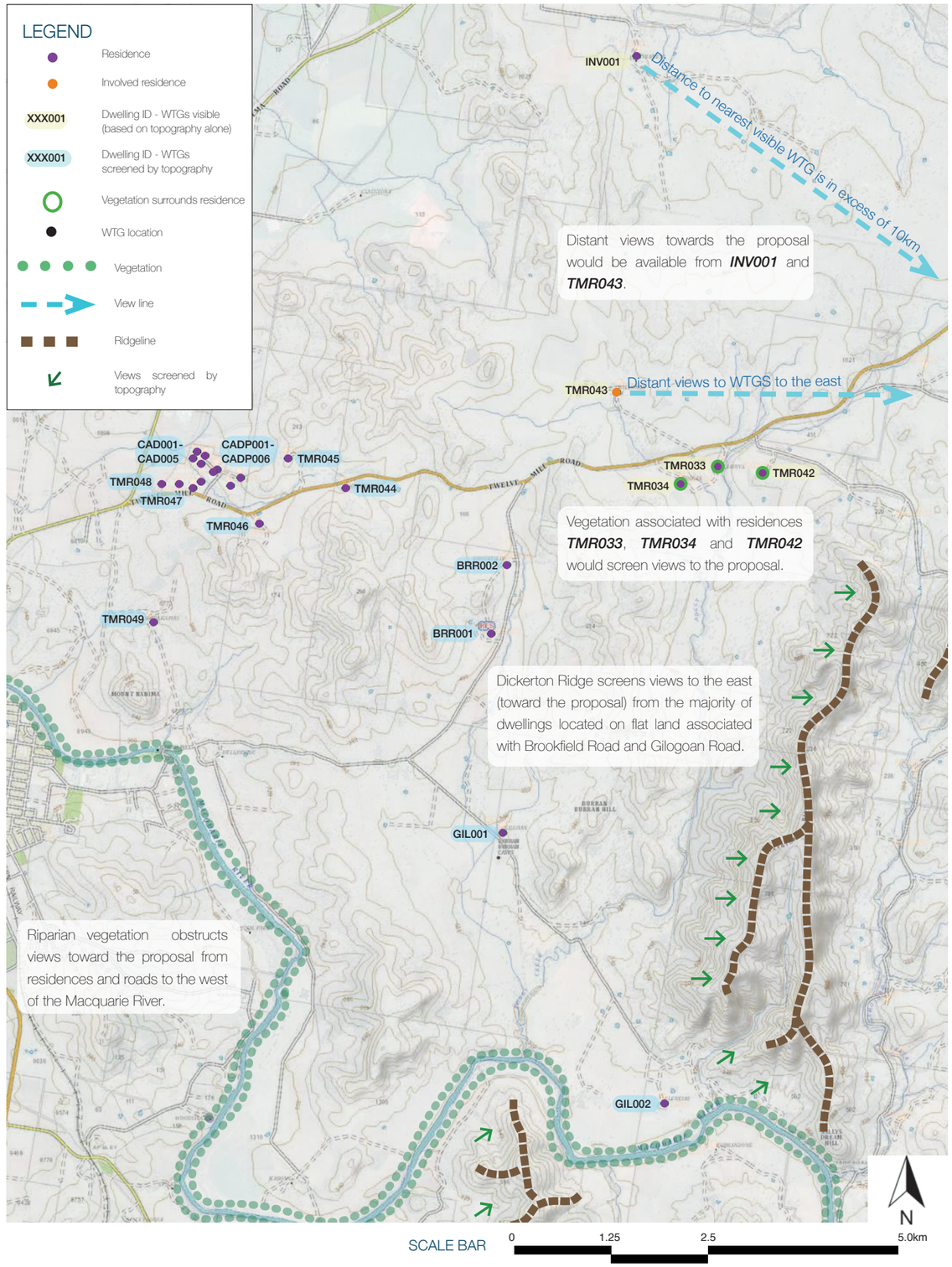


Figure 16: Visual Assessment LCU01: Wellington *(Map Source: SIX Maps 2019)*

11.0 Overview of Visual Impacts

11.3 LCU02 Bodangora (Refer to LCU Overview in Section 5.6)

11.3.1 Visual Assessment

The Bodangora LCU is characterised by slightly sloping grazing land located to the north of the proposal. Land is generally cleared with some scattered vegetation and riparian vegetation associated with drainage and creek lines. The proposal is located to the south east of the LCU.

Views towards the south (in the direction of the Project) are expansive from elevated residences in the north associated with Goolma Road (ie. GOOR001 and GOOR002). Views from these residences are in excess of 8 kilometres and some existing elements (such as vegetation and ancillary buildings) would assist in screening views.

Although located closer to the Project, residences associated with Twelve Mile Road are limited to views of between 10 to 30 wind turbines. Undulating topography to the south of Twelve Mile Road assists in screening parts of the proposal. In addition, roadside planting and screen planting surrounding residences generally fragments views.

11.3.2 Visual Performance Objectives

Visual Magnitude

Three non-involved residences are located within 3.35km (below the black line) of the proposal (**TMR022, TM023** & **TMR031**). One non-involved residence (**TMR036**) is located between the blue and black line (between 3.35-5km). Mitigation principles for this residence is outlined in **Section 12** and specific mitigation options are identified in **Appendix H.**

Landscape Scenic Integrity

The proposed wind turbines will be visible from a number of public and private viewpoints within the LCU. It is likely these will form a part of the landscape, however they will are unlikely to significantly modify the visual catchment of the area identified as 'Bodangora LCU'.

Key Landscape Features

The Bodangora LCU is predominantly flat and cleared for agricultural purposes with undulating hills to the south of Twelve Mile Road. The proposed wind turbines may become a noticeable visual element in views towards the undulating hills towards the south from some viewpoints. For the most part the undulating hills and grazing land that define the LCU will remain the key landscape feature of this area.

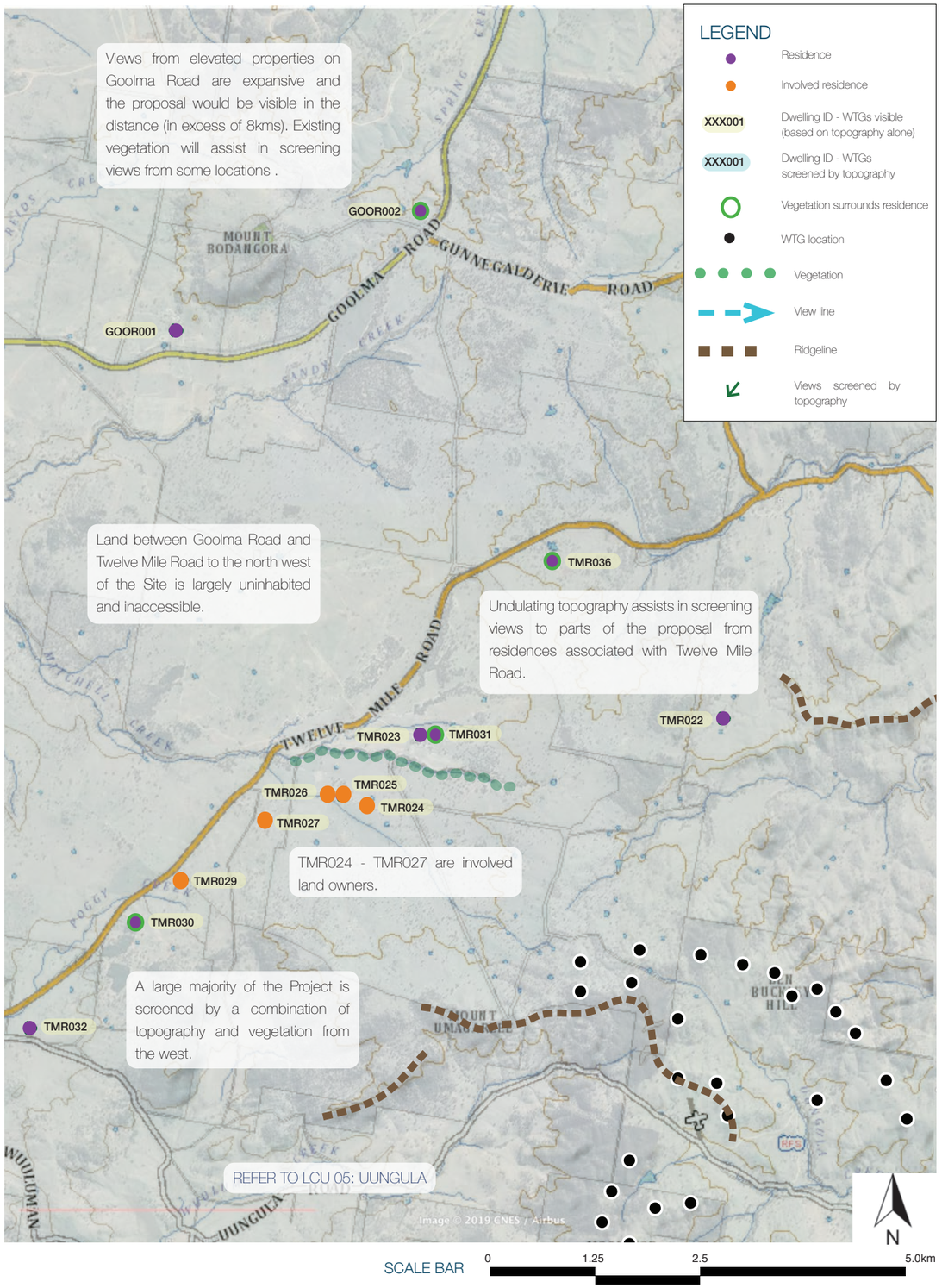


Figure 17: ***Visual Assessment LCU02: Bodangora*** *(Map Source: SIX Maps 2019)*

11.0 Overview of Visual Impacts

11.4 LCU03 Spicers Creek (Refer to LCU Overview in Section 5.7)

11.4.1 Visual Assessment

The Spicers Creek LCU is characterised by the undulating grazing land to the north west of the proposal with scattered vegetation throughout.

Views are elevated from residences associated with Gunnegalderie Road (**GUNR001-004**) to the north of the proposal. Views from these residences are distant (in excess of seven kilometres) and some existing screening elements (such as vegetation and ancillary buildings) would assist in screening views.

Undulating topography is likely to assist in obstructing views to the proposal from many parts of Twelve Mile Road. Wind turbines are in excess of 5 kilometres from residences associated with Twelve Mile Road to the north of the Site. A small number of WTGs are likely to be visible in the distance from **TMR021** and **TMR020**. Topography obstructs views from **TMR041** and **TMR018 -19**.

11.4.2 Visual Performance Objectives

Visual Magnitude

All residences within the Spicers Creek LCU are located in excess of 5 kilometres from the proposed wind turbines.

Landscape Scenic Integrity

The Project is likely to be partially visible from a small number of residences and public viewpoints within the Spicer Creek LCU. The Project is likely to form only a small element in the visual catchment, and are unlikely to significantly modify the landscape.

Key Landscape Features

The undulating grazing land, creeklines and scattered vegetation which characterises the Spicers Creek LCU will remain the key landscape features of the area. The proposed WTGs are likely to be a small element visible to varying levels from some areas, however they will not dominate the visual landscape.

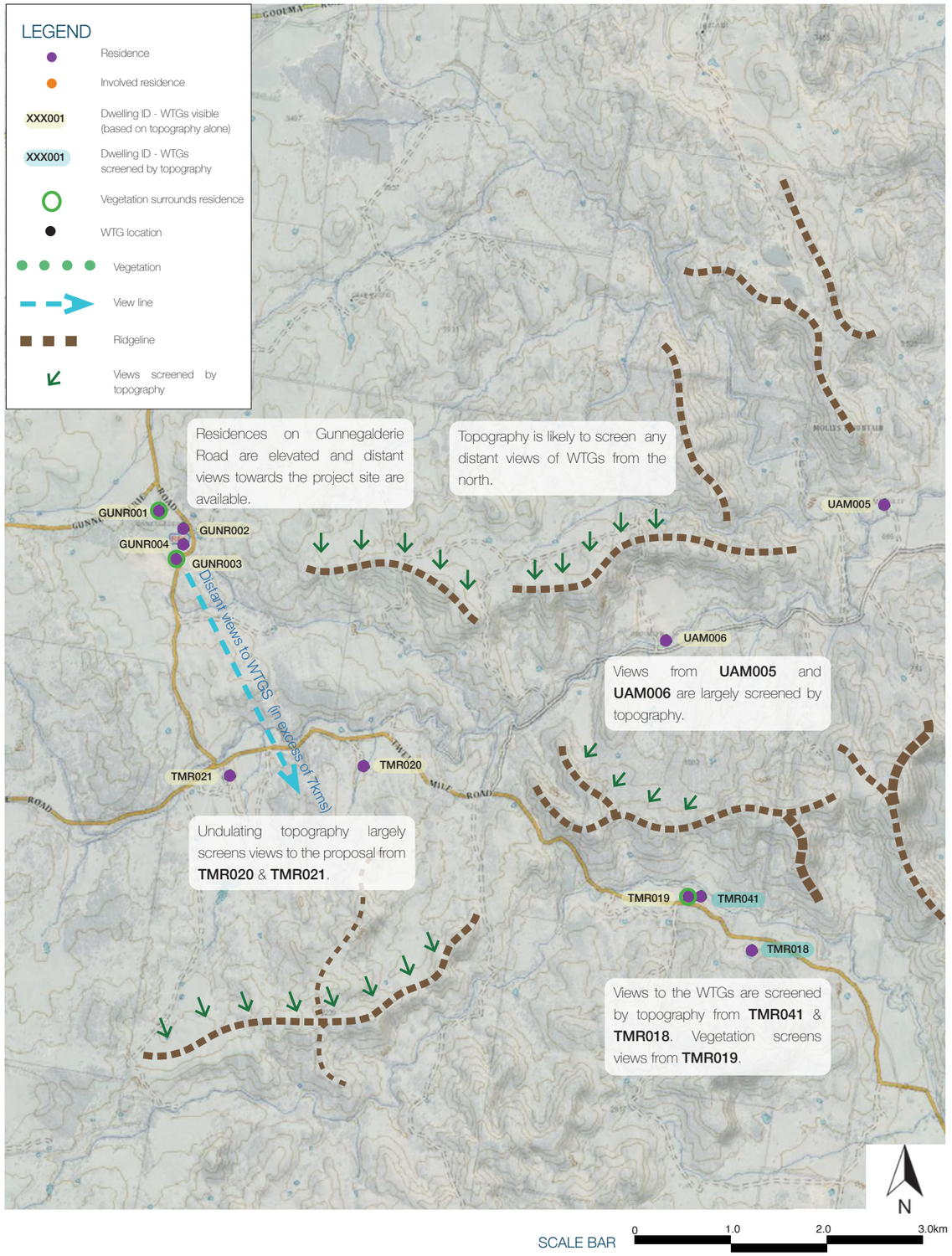


Figure 18: ***Visual Assessment LCU03: Spicers Creek*** *(Map Source: SIX Maps 2019)*

11.0 Overview of Visual Impacts

11.5 LCU04 Wuuluman (Refer to LCU Overview in Section 5.8)

11.5.1 Visual Assessment

The Wuuluman LCU is located immediately west of the proposed wind farm and is generally characterised by the valley between Dickerton Ridge and Yarragal Ridge. Residences within the LCU are located on the valley floor accessed via Wuuluman Road which follows Wuuluman Creek in a south direction towards the Macquarie River.

Views from the south are largely contained by peaks and foothills of the Yarragal Ridge and Billys Mountain. Vegetation associated with the Macquarie River screens views towards the north east towards the proposed from residences on Burrel Creek Road.

The highest visual impact is likely to be felt by elevated residences at the northern end of Wuuluman Road. **WUU001** in particular is likely to see the wind farm in its entirety due to the elevated position of the residence and minimal screening factors. Dwellings **WUU005** - **WUU009** have varying levels of visibility towards between 1-25 proposed wind turbines. Screen planting and structures near the dwellings would reduce the potential visual impact from most of these residences.

11.5.2 Visual Performance Objectives

Visual Magnitude

Three non-involved residences associated with LCU04 are located within 3.35km (below the black line) of the proposal (**WUU005, WUU007** and **WUU008**). Three non-involved residences (**WUU001, WUU006** and **WUU009**) are located between the blue and black line (between 3.35-5km). Further assessment of these residences has been undertaken in **Appendix G** and where required, mitigation methods for these residences are outlined in **Appendix H.**

Landscape Scenic Integrity

The Project is likely to be visible from elevated areas within the LCU, however it is unlikely to significantly modify the visual character of the Wuuluman LCU. The wind turbines will be a minor element in the visual landscape visible from limited areas within the LCU.

Key Landscape Features

The key landscape features identified for the Wuuluman LCU are the densely vegetated ridges associated with Dickerton Ridge and Yarragul Ridge which form the valley upon which residences are located. The proposed wind farm may be visible from some areas of the LCU, however the hills and creek will remain the dominant feature of the landscape.

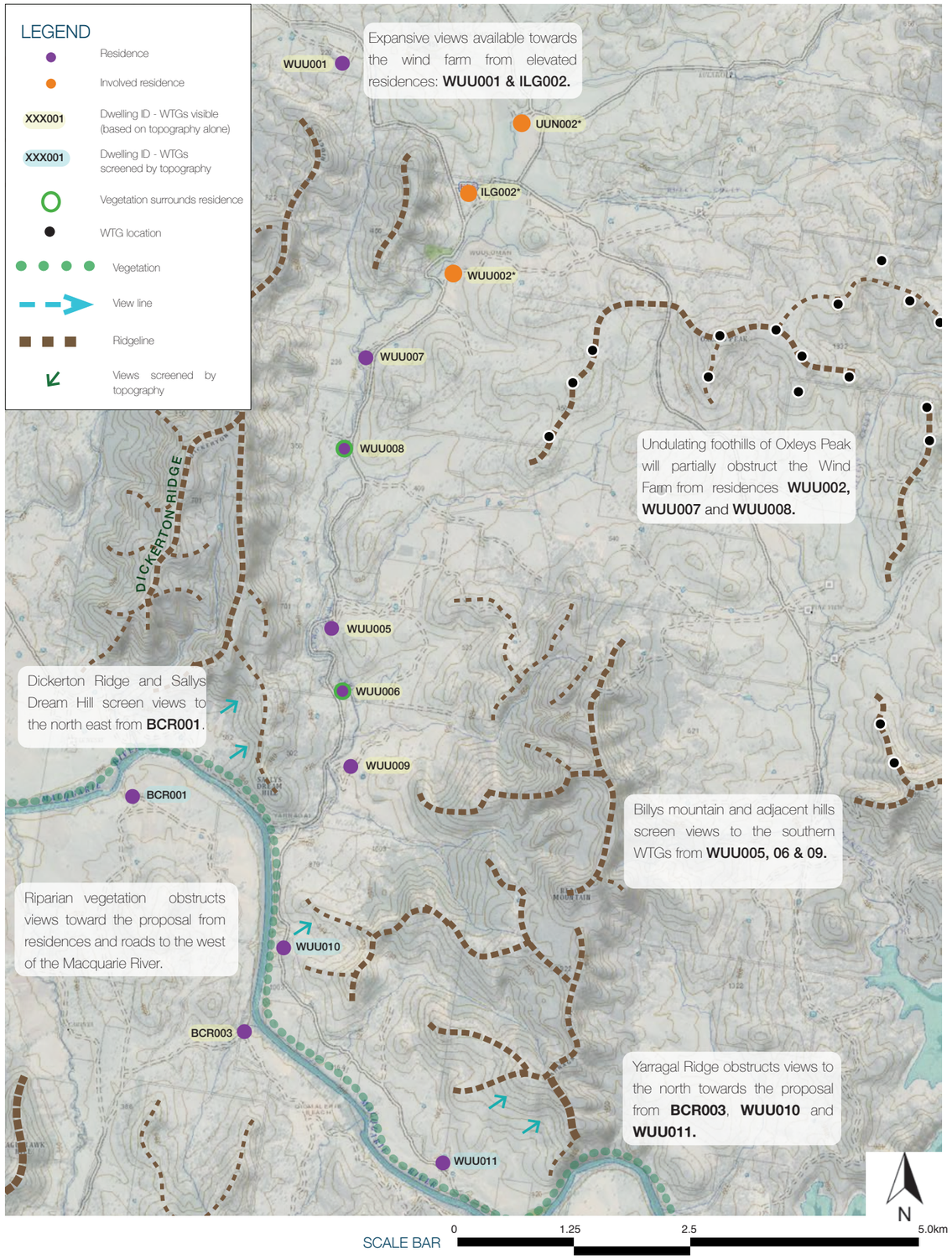


Figure 19: Visual Assessment LCU04: Wuuluman *(Source: SIX Maps 2019)*

11.0 Overview of Visual Impacts

11.6 LCU05 Uungula (Refer to LCU Overview in Section 5.9)

11.6.1 Visual Assessment

The Project is located within the area identified in this report as the Uungula LCU. The Uungula LCU is characterised by undulating topography which has been modified for agricultural purposes. The LCU is largely uninhabited with limited opportunities for access throughout the landscape with the exception of a few unsealed roads which provide access to isolated homesteads.

Residences within the LCU are limited to Uungula Road and Ilgingerry Road. Due to their close proximity to the proposal, all residences assessed within the LCU will have views to proposed wind turbines (with the exception of UUN013). However, there are no opportunities to views the wind farm in its entirety due to undulations in the topography.

There are six non-involved dwellings within the Uungula LCU. Five of these dwellings are located within relatively close proximity (between 0.8km - 3.8km) to the nearest WTG. Although within close proximity to the proposal, topography assists in obstructing the majority of WTGs from the view of residences to the north and east of the proposal (**TMR016**, **UUN007**, **UUN008**). Views to the proposal would be screened by topography from **UUN013**. **ILG006** is a derelict house and an assessment is not warranted.

11.6.2 Visual Performance Objectives

Visual Magnitude

Two non-involved residences (***UUN008 & TMR016***) are likely to have views of proposed wind turbines. Mitigation methods are likely to assist in reducing the potential visual impacts from these dwellings. Refer to **Appendix H.**

Landscape Scenic Integrity

The Uungula LCU was rated as having a moderate scenic quality. The proposed wind turbines are likely to become one of the more dominant elements in the landscape, and are likely to alter the landscape character of the Uungula LCU. The most affected areas are those that are largely uninhabited.

Key Landscape Features

The proposed Wind Farm is likely to become a major element in the landscape of the area identified as Uungula LCU. The area within which the Site is located is predominantly uninhabited and therefore opportunities to views the proposal are contained to roads and residences. Due to the undulating topography opportunities to views the proposal in its entirety are unavailable from with the LCU.

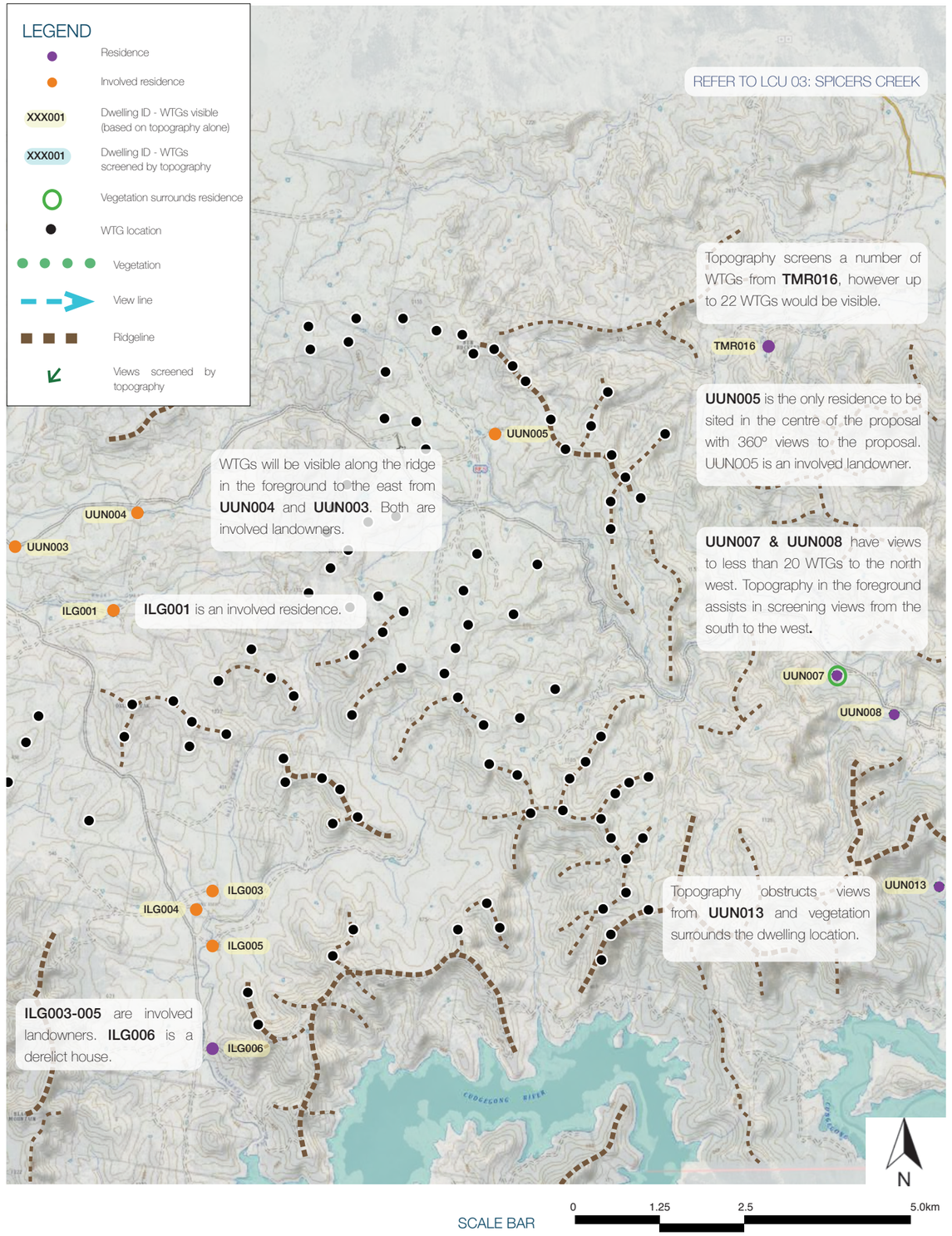


Figure 20: Visual Assessment LCU05: Uungula *(Source: SIX Maps 2019)*

11.0 Overview of Visual Impacts

11.7 LCU06 Burrendong (Refer to Section 5.10)

11.7.1 Visual Assessment

The Burrendong LCU is located to the south of the Study Site and includes land surrounding Lake Burrendong, the southern end of Cudgegong River and Meroo River. Land in the area is largely uninhabited, with the exception of several residences on the north eastern edge of the Lake along the Meroo River and a few associated with Burrendong Dam Road. Cudgegong River Park is a crown land reserve dedicated for public recreation and includes cabins and camp sites.

Residences associated with the southern end of Yarrabin Road are situated on flat land along Meroo River. Due to their low elevation, views from these residences are contained by elevated ranges to the west and there will be no visible WTGs from these residences. Views towards up to 30 WTGs may be available from some areas within Cudgegong River Park, however for the most park, cabins and accommodation is orientated towards Cudgegong River. Views within the park are partially contained by vegetation and structures.

A large area of land to the south of Lake Burrendong is zoned E3 Environmental Management with the objective to allow for a range of low impact recreational activities and ancillary land uses in the Burrendong State Park that protect and enhance the environmental and scenic qualities of the park and the water quality of Lake Burrendong. A number of unsealed tracks run through the landscape, however land is undulating and densely vegetated, with views contained for the most part.

11.7.2 Visual Performance Objectives

Visual Magnitude

All residences in the LCU are located in excess of 5 kilometres from the proposal.

Landscape Scenic Integrity

Views from within the LCU are generally contained by topography. Views of Lake Burrendong, Cudgegong River and Meroo River are unlikely to be impacted. The proposed wind turbines will become a small visual element on the ridgeline to the north west of Cudegong River Park.

Key Landscape Features

Lake Burrendong was identified as being valued by the local community. Although there may be wind turbines visible from some areas within the uninhabited land, views of Lake Burrendong and the distant vegetated ranges would remain the dominant landscape feature of the area. Billys Mountain, Pine Hill remain dominant features in the visual landscape.

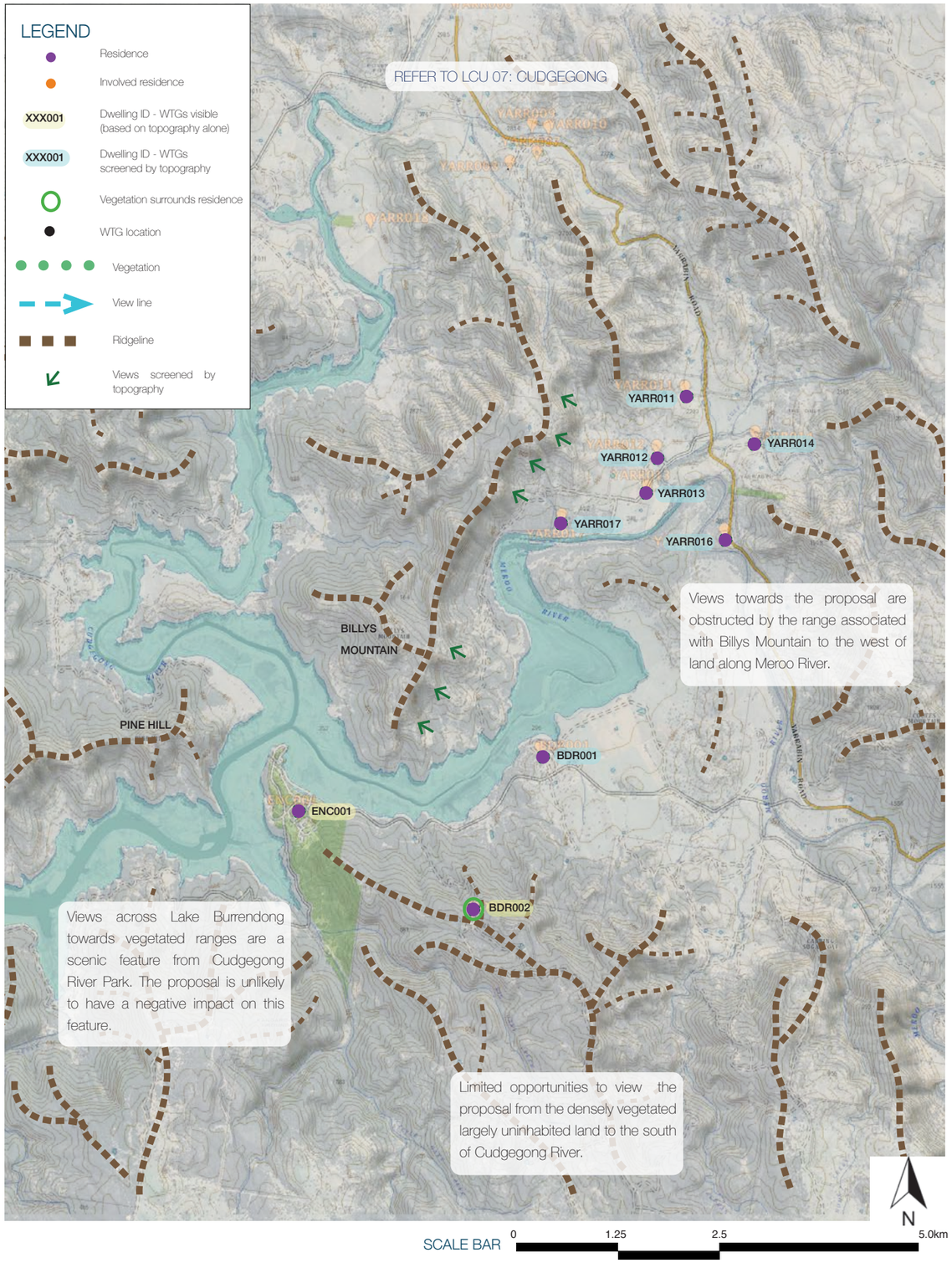


Figure 21: ***Visual Assessment LCU06: Burrendong*** *(Source: SIX Maps 2019)*

11.0 Overview of Visual Impacts

11.8 LCU07 Cudgegong (Refer to Section 5.11)

11.5.1 Visual Assessment

The Cudgegong LCU is characterised by land associated with the Cudgegong River to the east of the Study Site. Land in this area is predominantly utilised for grazing with residences accessed via Yarrabin Road, which runs along the eastern side of the Cudgegong River. Undulating land contains views from the LCU as well as scattered vegetation and riparian vegetation associated with the Cudgegong River.

Topography to the west of Cudgegong River screens views toward the proposal from ***TMR017***, ***YARR004***, ***UUN010*** and ***UUN011***. Views to the nearest WTGs immediately west of the LCU are screened by topography from ***UUN009***, ***YARR005*** and ***YARR006***, however distant views to WTGs to the south may be available.

Views to the proposed WTGs to the west (in excess of 5 kilometres) would be available from the cluster of residences located near the intersection of Yarrabin and Twelve Mile Road. Views to the south WTGs are generally screened from these properties. The proposed wind turbines will be visible to the west from ***YARR007-YARR010***.

The highest visual impact from Cudgegong LCU is likely to be from ***YARR018***, due to the elevated position of the residence, views to approximately 50 WTGs would be visible in the distance (in excess of 6 kilometres).

11.5.2 Visual Performance Objectives

Visual Magnitude

All residences are located in excess of 5 kilometres from the nearest proposed WTG.

Landscape Scenic Integrity

The scenic integrity of the Cudgegong LCU is likely to be slightly modified by views to varying number of proposed WTGs. The proposed WTGs are likely to form a minor element in the overall visual landscape identified as the Cudgegong LCU.

Key Landscape Features

The Cudgegong River and surrounding undulating topography will remain the dominant landscape features of the LCU.

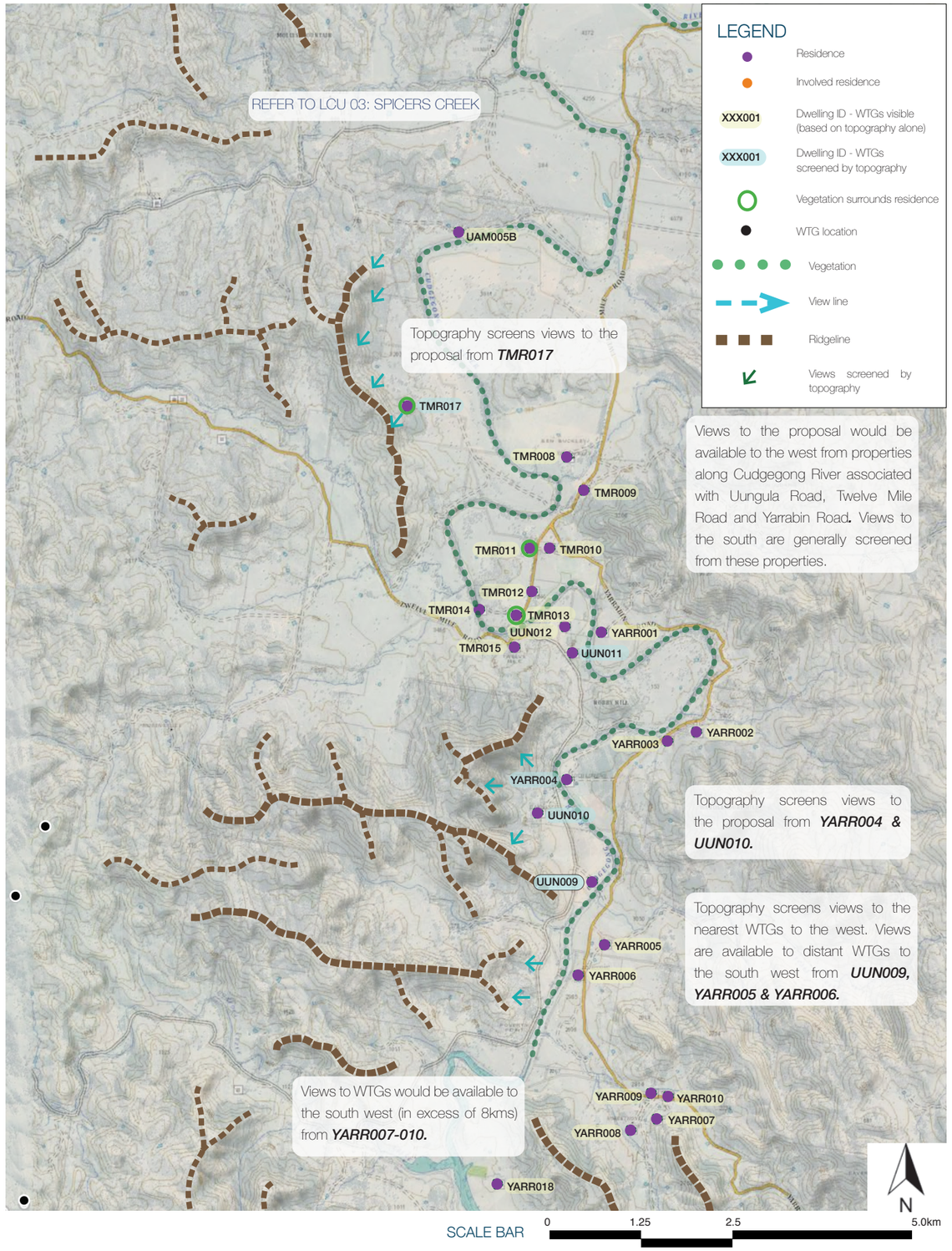


Figure 22: Visual Assessment LCU07: Cudgegong *(Source: SIX Maps 2019)*

11.0 Overview of Visual Impacts

11.9 Summary of Impact on Landscape Character

The proposed development is to be located within a predominantly agricultural landscape that has not been identified as significant or rare. The broad landscape character is dominated by established rural land which consists primarily of highly modified and degraded undulating hills. Generally, the *Scenic Quality Classes* of the Landscape Character Units (LCU) within the Study Area have been rated as low to moderate (refer to ***Section 5.4***).

The fact that the proposed wind turbines are generally positioned within a landscape that has remained largely unchanged for decades means that the potential for contrast is significant. There is little doubt that the Uungula Wind Farm, regardless of how visible it actually is, would become a feature of the area. However, the degree to which the existing landscape character and significance is altered as a result of the proposal, is determined by the dominance of the proposal in relation to the existing landscape features.

Where proposed wind turbines are more visually dominant it is likely the existing landscape character would be altered. It is likely the highest visual impact on the existing landscape character will be experienced within close proximity to the proposal where the proposed turbines are a dominant visual feature. For example, the Uungula LCU was rated as moderate, there is limited diversity in the landscape and no dramatic topographical feature which dominates the landscape. In this setting the proposed wind turbines would become one of the more dominant elements in the landscape.

Certain areas of the visual catchment have been determined as having a medium *scenic quality class.* An example of this is the Burrendong LCU which was assessed as having a moderate landscape quality (***Refer to Section 5.5.7***). The area is predominantly utilised for recreation and is valued for its expansive views over Lake Burrendong towards distant ranges. It is these dominant and contrasting features of the Burrendong LCU that reduce the extent to which the existing character is likely to be altered by the proposal. The proposed wind farm would form a visual element in the overall landscape, however the expanse of the lake and extent of surrounding vegetated ridgelines would remain the dominant feature (refer to ***Photomontage 17***).

Regionally, significant landscape features identified in ***Section 5.2*** of this report, would remain dominant features of the landscape and it is unlikely the proposal would degrade the scenic value of these landscape features.

It is undeniable the proposed wind farm would become a feature of the visual landscape. However, it is likely the character of areas which are valued for their high landscape quality and utilised for recreation and tourism will remain intact.

11.10 Summary of Impact on Dwellings

Tables G1 - G7 in ***Appendix G*** provide an overview of the potential visual impacts from each dwelling located within 8 kilometres of the proposed wind turbines. An assessment of each residence was undertaken using a combination of topographic mapping, latest available aerial imagery and field work. Note, that for consistency through the report, the summary tables have been grouped into LCU's (as defined in ***Section 5.0***).

A total of 111 residences have been assessed within 12 kilometres of the Project. Topography alone screens views to the Project from 39 of these residences. There are 14 non-involved residences (and one derelict house - ILG006) within 5 kilometres, with varying degrees of visibility, four (4) of these residences within 5kms are unlikely to have views to the Project due to topography or existing vegetation (UUN007, UUN013, WUU006 and WUU008).

In accordance with the Bulletin, detailed assessment of the remaining ten (10) residences has been undertaken and where possible mitigation methods have been identified (see ***Section 12*** and ***Appendix H***).

11.0 Overview of Visual Impacts

11.11 Impact of Associated Infrastructure

In addition to the proposed wind turbines, the associated infrastructure (described in ***Section 3.4*** of this report) is likely to contrast with the existing visual landscape. Due to the large scale and generally isolated siting of the proposed wind farm, transmission lines, access roads and other ancillary structures have the potential to alter the existing visual landscape. An overview of the potential visual impact resulting from associated infrastructure and project components is provided in this section of the report.

11.11.1 Transmission Lines

Electrical and control cables will comprise a mix of underground and overhead transmission lines (refer to ***Section 3.4***). Where possible, underground transmission lines are likely to be utilised between wind turbines and follow site access routes. The proposed power lines are generally located on private agricultural land and opportunities to view the power lines from public land are limited.

Generally the above ground transmission lines are proposed along access roads and existing cleared land to reduce the need for clearing of vegetation. The proposed transmission lines are visually similar to existing power line structures which are a common element throughout the existing visual landscape. The proposed transmission lines would therefore appear as an extension of the existing power lines in the landscape. If design principles outlined in ***Section 12.0*** are incorporated the visual impact would be minimal.

11.11.2 Access Roads

Access roads are proposed off site connecting to existing arterial roads, and on site between the wind turbines. Where practical, it is proposed access roads will follow existing farm tracks that transverse the ridge lines and plateaus. Construction of the on-site access road network will require earth works to level areas of steep gradient.

Generally, access roads have been sited to reduce potential vegetation loss and limit earth work requirements. Due to the existing agricultural land use of the Study Area, farm roads transversing the landscape form a significant part of the existing landscape character. The proposed access roads are likely to be viewed as part of the existing character of the landscape and therefore visual impact would be low. Mitigation measures outlined in ***Section 12.0*** of this report provides recommendations for reducing the potential visual impact resulting from access roads.

11.11.3 Ancillary Infrastructure & Project Components

An overview of the potential visual impact resulting from ancillary infrastructure and project components is included in the following section of the report. The potential visual impact of night lighting on ancillary infrastructure is assessed in **Section 10.3** of this report**.** The electrical infrastructure has been designed to minimise the visual impact of the Project by siting the infrastructure away from residences and surrounding public viewpoints as far as practical whilst maintaining the practical and operational needs of the infrastructure.

Hardstands

The hardstand areas would be maintained throughout the operational life of the project and utilised for maintenance. The clearing of native vegetation for the construction of internal roads and hardstand areas will be undertaken in accordance with the combined impacts evaluated in the EIS and minimised where practicable. If clearing is found to be unavoidable, this will be appropriately managed and carried out in accordance with the Development Consent.

Permanent Meteorological Masts

Approximately six permanent meteorological masts (potentially including the retention of existing temporary monitoring masts), up to hub height (max. 165m), will be installed on-site. The wind monitoring masts are likely to be visible, however due to the large scale of the study area and the narrow design of the wind masts it is likely they would form only a small element in the overall landscape and the visual impact would be minimal.

Operations Facility Building

One or more facilities buildings will be constructed to service the project. The proposed facilities buildings have been located to minimise visibility from existing public viewpoints. Mitigation methods outline in **Section 12.0** of this report would reduce any potential visual impacts resulting from the construction of operations facility buildings.

Substations

Three potential substation locations have been identified and have been chosen to minimise access distance and electrical losses, and to reduce their visibility from surrounding public viewpoints.

Following construction, and if warranted, raised earthwork perimeters and small areas of native tree planting may be undertaken to screen any parts of the substation that are visible from the surrounding country to reduce noise and visual impact. If located in excess of 2 kilometres away from residences and with screen planting in keeping with the existing character of the landscape, the substations are unlikely to result in a negative visual impact.

12.0 Mitigation Methods

12.1 Overview of Mitigation Methods

This section of the report provides recommendations which seek to achieve a better visual integration of the proposal and the existing visual character at both local and regional scales. The mitigation measures attempt to lessen the visual impact of the proposed wind farm whilst enhancing the visual character of the surrounding environment.

Mitigation measures are best considered as two separate phases. These include:

- Primary measures that form part of the development of the wind farm design through an interactive process;
- Secondary measures designed to specifically address the remaining (residual) negative (adverse) effects of the final development proposals (The Landscape Institute et al 2008).

It is important to note that the mitigation methods proposed in this report are made notwithstanding issues raised by other consultants (eg. engineering, ecology, geology etc.). During the planning and design phase of a wind farm mitigation strategies should also be considered to lessen the visual impact of the proposal. This is by no means an exhaustive list, however the adoption of these recommendations will assist considerably in ensuring the proposal contributes positively to the visual quality and character of the area.

12.2 Wind Farm Design

The design of the proposed wind farm is a primary measure of mitigation. The general principles employed through the project design phase can significantly reduce the visual impact. These include siting, access, layout and other principles which directly impact the appearance of the proposed development. General guidelines for the design development of the Project have been outlined in the following section.

12.2.1 Wind Farm Layout and Size

The layout and size of the wind farm is a significant factor in the visual impact on the landscape. According to Stanton (1995) the intrusiveness of a wind farm is not directly proportional to the number of turbines in an array, and instead, more a factor of design feature. For example, large wind farms may appear less dominating than a smaller project when the large wind farm is subdivided into several visually comprehensible units.

It is suggested that fewer and more widely spaced turbines present a more pleasing appearance than tightly packed arrays (URBIS, 2009). The following principles should guide the design process of the wind farm:

- Controlling the location of different turbine types, densities and layout geometry to minimise the visual impacts.
- The lines of turbines should reflect the contours of the natural landscape as best as possible.
- Ensure the turbines are evenly spaced to give a regular pattern creating a better balance within the landscape.

It is important to note that due to ongoing development in technology the Project has undergone many changes. The resulting layout has a substantially smaller development footprint to those previously considered.

12.2.2 Wind Turbine Design and Colouring

Turbine design and colouring are an important factor. The turbines will have a matte white finish and consist of three blades which is consistent with the current turbine models being considered. It is understood that wind turbines with three blades are generally more balanced than turbines with only two blades (Arkesteijn and Westra, 1991).

The important factors to achieving a visual consistency through the landscape include:

- 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.

12.3 Mitigation Methods - Residences

In accordance with the Bulletin, a detailed assessment of residences has been undertaken and (where possible) mitigation methods have been recommended (see ***Appendix H***) to assist in reducing any residual impacts. ***Table H1*** in ***Appendix H*** provides an overview of the ten (10) residences identified through the Visual Assessment which may benefit from the application of mitigation methods outlined in this section of the report.

Of the ten residences identified, nine would benefit from screen planting or supplementary planting. Most have existing planting in the form of screen planting or scattered vegetation nearby. Supplementary planting would reduce the visibility of wind turbines from the majority of residences. ***WUU001*** is the only residence identified which is unlikely to benefit from screen planting. Views from residence ***WUU001*** are expansive due to its elevated position and as a result include vistas across the landscape towards the proposal. Screen planting would be an effective method to conceal these views, however it would obstruct desirable views across the landscape.

12.0 Mitigation Methods

12.3.2 Residence Screen Planting

In circumstances where residences are subject to a high level of visual impact, screen planting is an option proposed to assist in mitigating views of turbines from residential properties. As the viewing location of the proposal would be generally fixed there is opportunity to significantly reduce potential visual impact from the proposal.

In order to achieve visual screening planting between the intrusive element and the homestead, tree planting should be undertaken in consultation with the relevant landowners to ensure that desirable views are not inadvertently eroded or lost in the effort to mitigate views of the turbines.

An example of how screen planting could be used to mitigate potential views towards visible WTGs from Dwelling ***TMR022*** is illustrated in ***Figure 23***. Note this is an *example only* and a detailed analysis would be required to determine the extent of visibility, existing planting and orientation of the residence. Existing scattered vegetation obstructs views towards some wind turbines from this location. Existing vegetation is scattered in the middle ground. Where screening may be required from a static position (ie. kitchen / living room window) screen planting sited away from the residence ensures desirable views across land are retained where possible, whilst selectively screening views to WTGs. An photomontage illustrating how planting could be used to obstruct views to wind turbines has been included from the yard of ***TMR022*** (see ***Image 23*** and ***Image 24***).

Image 23. Potential view of WTGs from Dwelling TMR022 without mitigation

Image 24. View from Dwelling TMR022 illustrating indicative placement of screening vegetation as per ***Figure 23***

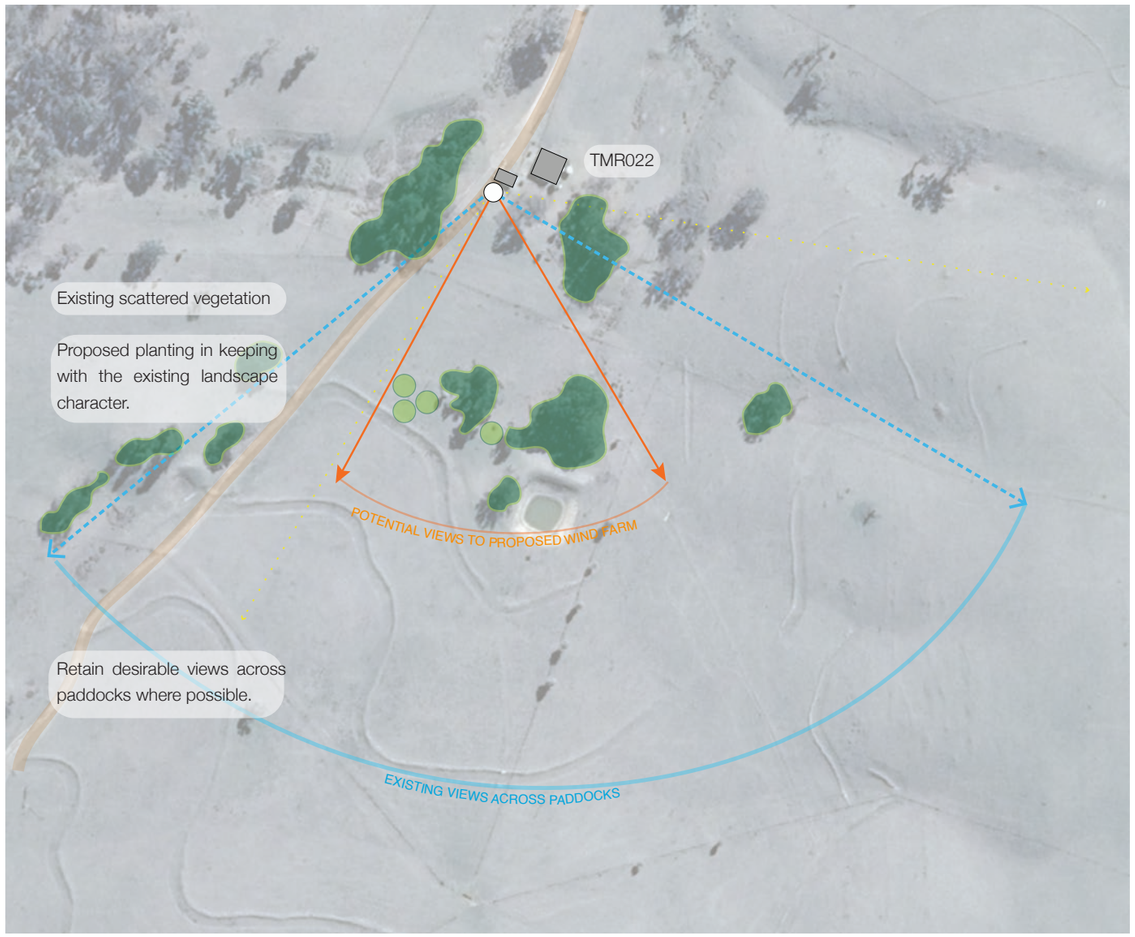


Figure 23: ***Example of screen planting set back from residence (TMR022)*** *(Image Source: Google Maps 2019)*

12.0 Mitigation Methods

12.4 Associated Infrastructure

The following section outlines principles to assist in reducing the visual impact of the associated infrastructure.

Transmission Lines

- Where possible underground cabling is to be used to connect wind turbines 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.

Access Roads

- Where possible utilise or upgrade existing roads, trails or tracks to provide access to the proposed turbines to reduce the need for new roads.
- Allow for the provision for down sizing 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.

Ancillary Structures

- Consideration should be given to controlling the type and colour of building materials used especially with the use of light, highly reflective cladding and brick and tile materials which contrast dramatically with the landscape character.
- 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.
- Limit above ground infrastructure apart from the turbine itself and the transformer at the base of the turbine.
- Boundary landscaping to assist in screening ancillary structures would significantly reduce the potential visual impact. Boundary screen planting is an effective mitigation method which could be utilised to ameliorate potential visual impacts resulting from the construction of ancillary structures with a small vertical scale such as collector substations, switching stations and the operations facilities building. An example of the successful screening of a substation is provided in ***Image 25***.

Image 25. Example of landscape screening along the boundary of a substation - Rothbury NSW.
(Image Source: MLA, 2012)

12.5 Landscaping Principles

Visual screen planting is a beneficial mitigation method used to assist in reducing the visual impact of the wind farm and associated infrastructure. Landscaping and screen planting can also be utilised to significantly reduce the affect of shadow flicker on both roads and residences. The existing character of the landscape allows for a variety of methods of landscaping and visual screening which will remain in keeping with the landscape character. General guidelines to adhere to when planning for landscaping and visual screening include:

- Planting should remain in keeping with existing landscape character.
- Species selection is to be typical of the area.
- Planting layout should 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.

Locally native plant species are preferred, as they will help assist and maintain the connectivity of the area and therefore. They 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 (ie. soil, climate, etc.) and will build on the existing vegetation assemblages in the area.

12.0 Mitigation Methods

12.6 Night lighting Recommendations

12.6.1 Aviation Hazard Lighting - Wind Turbines

To assist in the amelioration of the effect of Aviation Hazards Lighting on wind turbines the following should be applied:

- If used, air navigation lights should be spaced over the array, particularly at the extremities. They are not required on every tower. According to the CASA requirements, shielding may be provided to restrict the downward spill of light to the ground plane by ensuring that no more than 5% of the nominal light intensity should be emitted at or below 5° below horizontal (***Refer to Figure 24***).
- No light should be emitted at or below 10° below horizontal.
- Where two lights are mounted on a nacelle, dynamic shielding or light extinction for the period that a blade is passing in front of the light is permissible providing that at all times at least one light can be seen, without interruption, from every angle in azimuth.
- Treatment of the rear of blades with a non-reflective coating to reduce reflection off the rotating blade at night.
- The CASA lighting requirements should be monitored by proponents and shielding or lower light should be implemented to lower illumination as much as possible.

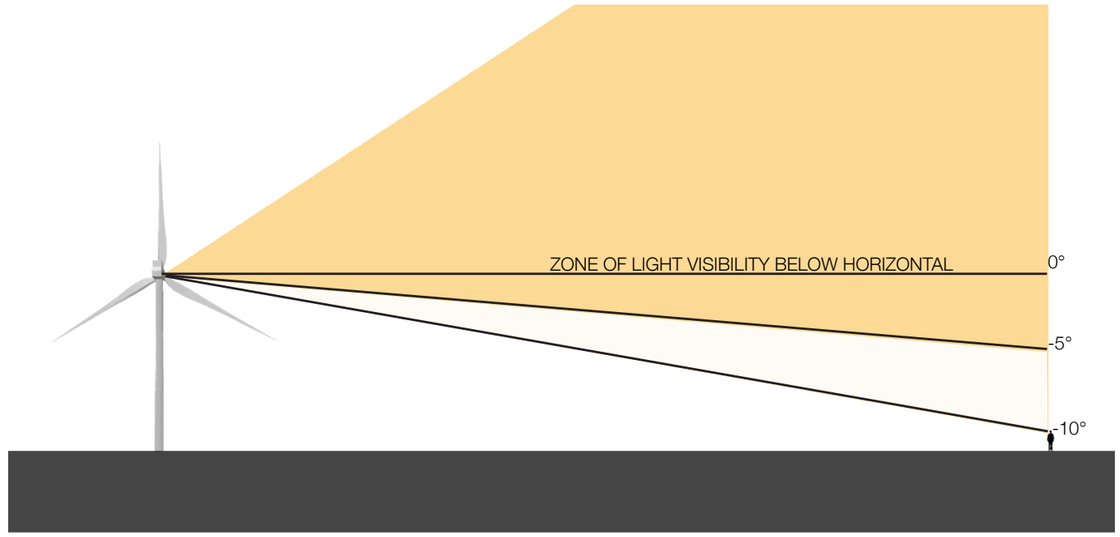


***Figure 24:* CASA Recommended Obstacle Lighting Spread** *(Image adapted from Urbis 2009)*

12.6.2 Night lighting - Ancillary Structures

To assist in the amelioration of the effect of night lighting on ancillary structures the following should be applied:

- Security lighting throughout the wind farm, switching station and the substation should be minimised to decrease the contrast between the wind farm and the night time landscape of the area.
- Motion detectors should be used to activate night time security lighting when required.
- Lighting is to be designed to ensure it does not spill onto nearby roads or residences.

13.0 Visual Performance Objectives

13.1 Evaluation of Visual Performance Objectives

In accordance with the Bulletin, the visual assessment requires an evaluation of the proposed wind energy project and its various components, turbines and ancillary facilities against the *visual performance objectives* of the project (refer to Table 2 of the Bulletin), using a combination of desktop and field evaluations.

The visual performance objectives are used as a framework for evaluation that enables potential impacts and management options to be considered objectively, against the varying levels of landscape significance established by the baseline study. Application of the visual performance objectives will allow for a transparent and robust assessment process. The following tables provides a brief summary of the objectives for each of the visual performance objectives and identifies the relevant sections of the LVIA where detailed assessments are located.

Visual Magnitude - Visual Performance Objectives		
Visual Influence Zone 1 Objectives:	**Visual Influence Zone 2 Objectives:**	**Visual Influence Zone 3 Objectives:**
Avoid turbines or provide detailed justification of turbines below the blue line (5km for Uungula WF)	*Manage impacts as far as practicable, justify residual impacts, and describe proposed mitigation measures below the black line (3350m for Uungula WF). Consider screening between the blue line and the black line.*	*Consider screening below the black line (within 3350m).*

Summary of LVIA Evaluation

- In accordance with the Bulletin, the visual magnitude is not determinative of acceptability, instead it provides a basis for the assessment to be undertaken.

Refer to Section 6.2: Preliminary Assessment Tools

Dwellings within 3350 m (below the black line):

- Eight (8) *non-involved* landowner dwellings (and one derelict house ILG006) were identified within 3350 metres of a proposed WTG: ***TMR016, TMR022, TMR023, TMR031, UUN007*, WUU005, WUU007, WUU008****
- *Note: Dwelling ***WUU008*** & ***UUN007*** are surrounded by vegetation and views to the Project are likely be screened.

Dwellings within 3350 m - 5000 m (between the blue and black line):

- Six (6) *non-involved* landowner dwellings were identified between 3350 - 5000 metres of the nearest proposed WTG:
- ***TMR036, UUN008, UUN013*, WUU001, WUU006*, WUU009***
- *Note: The Project would be screened by topography or vegetation from two (2) of the dwellings (***UUN013 & WUU006***).

Refer to Figure B1 and Tables B1 & B2 Appendix B: Visual Magnitude

Summary of LVIA Evaluation (continued)

- Further detailed assessment has been undertaken for each of these dwellings and a *Visual Influence Zone* was applied to each dwelling.

  Refer to Tables G1-G7 - Appendix G: Overview of Residences.
- Suitable mitigation methods have been identified for each dwelling in accordance with the Visual Performance Objectives.

  Refer to Appendix H and Section 12: Mitigation Methods

Visual Influence Zone 1 Dwellings:

- **TMR016:** Potential to incorporate screen planting to assist in reducing the potential visual impacts.

Visual Influence Zone 2 Dwellings:

- **WUU005, WUU007, WUU009, TMR022, TMR023, TMR031, UUN008:** Screen planting in accordance with Visual Performance Objectives
- **WUU001:** Dwelling is in an elevated position, difficult to screen due to expansive views (see *Photomontage 18*).

Visual Influence Zone 3 Dwellings:

- **TMR036:** Dwellings are located in excess of 3350m. Objectives suggest screening for dwellings within 3350m only.

*Table 15: **Summary of Visual Performance Objectives: Visual Magnitude***

13.0 Visual Performance Objectives

Landscape Scenic Integrity

Visual Influence Zone 1 Objectives	Visual Influence Zone 2 Objectives	Visual Influence Zone 3 Objectives
Wind turbines should not cause more than a low level modification of the visual catchment. Turbines are seen as either very small and/ or faint, or as of a size and colour contrast (under clear, haze-free atmospheric conditions) that they would not compete with major elements of the existing visual catchment.	*Wind turbines should not cause more than a low level modification of the visual catchment. Turbines are seen as either very small and/ or faint, or as of a size and colour contrast (under clear, haze-free atmospheric conditions) that they would not compete with major elements of the existing visual catchment.*	*No Visual Performance objective applies.*

Summary of LVIA Evaluation

- The Visual Influence Zone (VIZ) was identified for each viewpoint and where relevant for VIZ1 & VIZ2 the objectives were evaluated. Refer to ***Appendix C***.
- The potential for the project to affect the Scenic Integrity of the existing landscape character was summarised for each Landscape Character Unit.

Overview Landscape Character Units

- **LCU01 Wellington:** The proposed wind turbines will not modify the visual catchment of the area identified as 'Wellington LCU'. There are only a small number of opportunities to view the proposal from within LCU from elevated positions on local farm roads.
- **LCU02 Bodangora:** The proposed wind turbines will be visible from a number of public and private viewpoints within the LCU. It is likely these will form a part of the landscape, however they will are unlikely to significantly modify the visual catchment of the area identified as 'Bodangora LCU'.
- **LCU03 Spicers Creek:** The proposed wind turbines are likely to be partially visible from a small number of residences and public viewpoints within the Spicer Creek LCU. The proposed WTGs are likely to form only a small element in the visual catchment, and are unlikely to significantly modify the landscape.
- **LCU04 Wuuluman:** The Project is likely to be visible from elevated areas within the LCU. Although a visible element in the landscape, it is unlikely the Project will significantly modify the visual character of the Wuuluman LCU.
- **LCU05 Uungula:** The Uungula LCU was rated as having a moderate scenic quality. The proposed wind turbines are likely to become one of the more dominant elements in the landscape, and are likely to alter the landscape character of the Uungula LCU. The most affected areas are those that are largely uninhabited.
- **LCU06 Burrendong**: Views from within the LCU are generally contained by topography. Views of Lake Burrendong, Cudgegong River and Meroo River are unlikely to be impacted. The proposed wind turbines will become a small visual element on the ridgeline to the north west of Cudegong River Park.
- **LCU07 Cudegong:** The landscape character of the Cudgegong LCU is likely to be slightly modified by views to varying number of proposed WTGs. The proposed WTGs are likely to form a minor element in the overall visual landscape identified as the Cudgegong LCU.

Refer to Section 11: Overview of LCUs

*Table 16: **Summary of Visual Performance Objectives: Landscape Scenic Integrity***

Key Feature Disruption

Visual Influence Zone 1 Objectives	Visual Influence Zone 2 Objectives	Visual Influence Zone 3 Objectives
Avoid wind turbines or ancillary facilities that result in the removal or visual alteration/disruption of identified key landscape features. This includes any major or visually significant landform, waterform, vegetation or cultural features that have visual prominence or are focal points.	*Minimise impact of wind turbines or ancillary facilities that result in the removal or visual alteration/disruption of identified key landscape features. This includes any major or visually significant landform, waterform, vegetation or cultural features that have visual prominence or are focal points.*	*No Visual Performance objective applies.*

Summary of LVIA Evaluation

- Key Landscape Features are identified in Section 5.0. The key features were identified through a combination of community consultation and landscape character assessment.
- The LVIA has assessed the key features of the area and it has been concluded that whilst the Project may impact views from some areas, key features identified through the landscape baseline study are likely to remain undisrupted by the proposal.

Overview of Landscape Character Units

- **LCU01 Wellington:** The vegetated hills associated with the Dickerton Ridge form a dramatic backdrop to views across grazing land to the east. The dramatic ridge associated with Dickerton Range will remain a visually prominent feature of the landscape from land within this LCU.
- **LCU02 Bodangora**: The Bodangora LCU is predominantly flat and cleared for agricultural purposes with undulating hills to the south of Twelve Mile Road. The proposed wind turbines may become a visual element in views towards the undulating hills towards the south from some viewpoints. For the most part the undulating hills will remain the key landscape feature of this LCU.
- **LCU03 Spicers Creek:** The undulating grazing land, creeklines and scattered vegetation which characterises the Spicers Creek LCU will remain the key landscape features of the area. The proposed WTGs are likely to be a small element visible to varying levels from some areas, however they will not dominate the visual landscape.
- **LCU04 Wuuluman:** The key landscape features identified for the Wuuluman LCU are the densely vegetated ridges associated with Dickerton Ridge and Yarragul Ridge which form the valley upon which residences are located. The proposed wind farm may be visible from some areas of the LCU, however the hills and creek will remain the dominant feature of the landscape.
- **LCU05 Uungula:** The Project is likely to become a major element in the landscape of the area identified as Uungula LCU. The area within which the Site is located is predominantly uninhabited and therefore opportunities to views the Project are contained to roads and residences. Due to the undulating topography opportunities to views the proposal in its entirety are unavailable from with the LCU.
- **LCU05 Burrendong:** Lake Burrendong was identified as being valued by the local community. Although there may be wind turbines visible from some areas within the uninhabited land, views of Lake Burrendong and the distant vegetated ranges would remain the dominant landscape feature of the area. Billys Mountain, Pine Hill remain dominant features in the visual landscape.
- **LCU07 Cudgegong:** The Cudgegong River and surrounding undulating topography will remain the dominant landscape features of the LCU.

Refer to Section 11: Overview of LCUs

*Table 17: **Summary of Visual Performance Objectives: Key Feature Disruption***

13.0 Visual Performance Objectives

Multiple Wind Turbine Effects

Objectives (Applies to all Visual Influence Zones)

Objective Applies to all Visual Influence Zones

- Avoid views to the proposed, existing and approved turbines within eight kilometres from Level 1 and Level 2 viewpoints, exceeding the following thresholds, or provide detailed justification:
- Level 1: (High Sensitivity) - Wind Turbines visible within the effective horizontal views of two or more 60º sectors.
- Level 2: (Moderate Sensitivity) - Wind Turbines visible within the effective horizontal views in three or more 60º sectors.

Summary of LVIA Evaluation

- All viewers identified using the Multiple Effect Tool (based on 2D plan assessment) are ***Level 2 Sensitivity (Rural Dwelling)***

  Refer to Section 6.2 and Appendix B

- One (1) derelict house was identified with the potential to view WTGs associated with the Uungula Wind Farm in up to three or more 60º sectors ***(ILG006).*** Note as this is a derelict house, it does not warrant further assessment.
- One non-involved dwelling (***TMR022***) was identified as having potential to view turbines from both the proposed Uungula Wind Farm and existing Bodangora wind turbines in up to three (3) 60º sectors (based on 2D assessment alone).

Refer to Figure B2 and Table B3 in Appendix B

- The Bulletin recommends further assessment to Rural Dwellings (Level 2 Sensitivity) identified as having the potential to view three (3) or more 60º sectors when using the Multiple Effect Tool.
- **TMR022:** Potential to view up to 3 sectors of Uungula and Bodangora Wind Farms. Topography screens views to Bodangora Wind Farm and number of WTGs associated with Uungula reducing the number of potential sectors to two which is an acceptable level.
- **ILG006:** Derelict House, it does not warrant further assessment.

Table 18: Summary of Visual Performance Objectives: Multiple Wind Turbine Effects

Shadow Flicker and Blade Glint - Visual Performance Objectives

Objectives (Applies to all Visual Influence Zones)

- Finish turbine blades with a low reflectivity surface treatment to ensure that blade glint is minimised.
- Minimise shadow flicker to not more than 30 hours per year and utilise available mitigation options to minimise shadow flicker.

Summary of LVIA Evaluation

Shadow Flicker:

- Shadow flicker assessment identified a total of two residences (**ILG005** and **UUN005**) would potentially be affected by shadow flicker caused by the proposed wind turbines.
- **ILG005** is an involved landowner. Potential shadow flicker is below the accepted max. 30 hours per year.
- **UUN005** is an involved land owner with potential shadow flicker in excess of 100 hours per year.

Refer to Section 10.1 of LVIA

Blade Glint:

- Turbines will be finished with a low reflectivity surface treatment to ensure blade glint is minimised.

Refer to Section 10.2 of LVIA

Table 19: Summary of Visual Performance Objectives: Shadow Flicker and Blade Glint

Aviation Hazard Lighting

Objectives (Applies to all Visual Influence Zones)

Objective Applies to all Visual Influence Zones

- Aviation Hazard Lighting (AHL) must meet the requirements of Australian Standard AS 4282 - 1997 and any prescribed or notified CASA requirement. Shield all AHL within 2 kilometres of any dwellings. Avoid strobe lighting.

Summary of LVIA Evaluation

- The visual impact from night lighting in the area is unlikely to have a significant visual impact on receptors including motorists and residents in the area. If required, there is a potential for lighting to incorporate shields to minimise the visibility of lighting below the horizontal plane.

Refer to Section 10.3 Night Lighting Assessment and Section 12.5 Night lighting Recommendations

Table 20: Summary of Visual Performance Objectives: Aviation Hazard Lighting

14.0 Conclusion

14.0 Conclusion

Wind turbines create a strong contrast in the landscape as a result of their large scale and lack of visual integration. To take advantage of the climatic conditions of the region, the proposed Uungula Wind Farm is sited at high altitudes along ridge lines. As a result wind turbines are likely to be visible from a number of locations throughout the Study Area.

Due to their large scale and contrasting character to the rural landscape, the proposed turbines will most likely become a dominant feature of the landscape when viewed within close proximity. Although consisting of a relatively large number of turbines, the proposed wind farm is spread over a considerable area of undulating land. Due to this undulating topography and the location of roads primarily along the valley floors, there are limited opportunities to view the proposal in its entirety.

The greatest visual impact is likely to be associated with residences within the immediate vicinity of the Project Site associated with Uungula Road. The majority of these residences are involved land owners. A small number from elevated residences would be likely to have views of the Project from Wuuluman Road and Illgingerry Road.

Due to a variety of screening factors, visual impacts vary between these receptors. Screen and wind break planting around residences along with retained native vegetation along ridgelines, roadsides and riparian corridors form an integral part of the existing landscape character of the area. This vegetation has the potential to considerably reduce the visual impact by fragmenting and concealing views to turbines therefore reducing their presence in the landscape. The proposed mitigation methods included in this report aim to build on the existing landscape character to assist in ameliorating visual impacts resulting from the proposal. If mitigation methods are employed it is likely that adverse visual impacts related to the proposal could be significantly reduced to an acceptable level at sensitive viewpoints such as rural residential properties.

With all visual impact assessments the objective is not to determine whether the proposed impact is visible or not visible, but to determine how the proposal will impact on the existing visual amenity, landscape character and scenic quality. If there is potential for negative impact, this impact, and any mitigation methods must be investigated in order to reduce the impact to an acceptable level.

The visual impact of the wind turbines are lessened as the distance of the vantage point from the Site is lengthened. The topography surrounding the wind turbines significantly alters the visibility of the proposed development 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 turbine locations.

It is inevitable that the placement of wind turbines in a rural landscape will alter the existing landscape character of the area to some degree. The proposed wind farm contrasts with the existing landscape character of the region which is typically rural, pastoral land with large expanses of vegetation. The degree of visibility will determine the impact on the landscape character. For example the Project is located within the Uungula LCU and it will alter the character of this LCU. However, the number of receptors within this area is relatively low. For most LCUs surrounding the Project, the turbines are likely to be seen as an element within the landscape, however key features identified through the landscape baseline study will remain the dominate features of the visual landscape.

Although this LVIA quantifies the visual impact of the proposed wind turbines, the overall visual impact of the wind farm will vary greatly depending on the individual viewer's sensitivity to and acceptance of change. The sensitivity towards change varies greatly depending on the user's connection with the landscape. For example visitors to the region travelling along Goolma Road may perceive the wind farm as an interesting feature of the landscape. This may contrast with a resident who passes the wind farm daily who may have a more critical perception of the visual presence of the wind farm.

Wind turbines have the potential to create a strong contrast in the landscape as a result of their large scale and lack of visual integration. However due to their simplicity in form (especially when compared to transmission lines, towers and associated infrastructure) wind turbines can be considered a temporary installation in the landscape due to their modular construction and relatively low impact during the construction phase.

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 Moir Landscape Architecture that the social, environmental and economical benefits of the proposed wind farm far outweigh the identified visual impacts associated with the proposed Uungula Wind Farm.

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