Valley of the Winds

APPENDIX D
LANDSCAPE AND VISUAL IMPACT ASSESSMENT

RAMBØLL Bright ideas. Sustainable change.

Landscape and Visual Impact Assessment
Valley of the Winds Wind Farm

moir landscape architecture

Prepared for: ***UPC\AC RENEWABLES AUSTRALIA***

Project No: ***1902*** Issue: ***REVISION C*** Date: ***28th February 2022***

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Executive Summary

Moir Landscape Architecture (Moir LA) have been commissioned by UPC\AC Renewables Australia to prepare a Landscape and Visual Impact Assessment (LVIA) for the proposed Valley of the Winds Wind Farm (the Project).

The Project is located in the Central Western Tablelands region of New South Wales (NSW), approximately 7 kilometres (km) southwest of Coolah along Black Stump Way and north of the Golden Highway. UPC\AC made an application for the construction, operation and decommissioning of a wind farm with an estimated capacity of 800MW in May 2020. SEARs were issued by the Department of Planning, Industry and Environment (DPIE) on 9th June 2020 for the construction, operation and decommissioning of a wind farm with an estimated capacity of 800 megawatts (MW). This LVIA relates to the installation, operation, maintenance and decommissioning of up to 148 Wind Turbine Generators (WTGs) of a maximum height of 250 metres.

In addition to the wind turbines, ancillary infrastructure including access tracks, road upgrades, underground and overhead electricity cabling, high voltage transmission line, substations, potential battery energy storage system, switching station, quarrying locations, concrete batching plants, potential workers accommodation village, operations and maintenance facility and grid connection to the existing 330 kV transmission line have been assessed in this LVIA.

Moir Landscape Architecture have utilised 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.

Field work was undertaken by Moir Landscape Architecture to develop a visual baseline against which the Project has been assessed. The assessment determined the regional landscape character is typical of the Central-West Tablelands region characterised by agricultural land predominately utilised for grazing, with some areas of remnant vegetation. The landscape was categorised into five (5) Landscape Character Units (LCUs). A quantitative frame of reference was applied to establish the Scenic Quality Rating of these LCUs which ranged from low to moderate.

The Scenic Quality Ratings are utilised in defining Visual Influence Zones which are assessed against objectives outlined in the Bulletin.

The Bulletin states generally, the visual impact of a wind energy project will depend upon the characteristics and values of the existing landscape, the extent to which the existing landscape is changed by the Project and how these changes are perceived by individuals and the broader community. The assessment, in conjunction with community consultation identified the key landscape features and viewpoints within the Study Area.

Key features which form a part of the existing landscape character would assist in reducing the potential for viewing the Project. These include large areas of vegetation on ridgelines and grazing paddocks, undulating topography, roadside vegetation and riparian vegetation associated with rivers or creek lines. The assessment found the Project could be undertaken whilst maintaining the key visual features of the landscape.

In accordance with the Bulletin, Moir LA applied the Preliminary Assessment Tools to the Project Layout to determine residences requiring detailed assessment. The assessment identified a total of 112 non-participating dwellings within the blue line of visual magnitude (4,950 m of the nearest turbine). The assessment identified:

- 42 non-participating dwellings located within the black line of visual magnitude (3,350 m from the nearest wind turbine) and;
- 70 non-participating dwellings between the black and blue line of visual magnitude (3,350 m - 4,950m from the nearest wind turbine)
- 25 of the non-participating dwellings between the black and blue line of visual magnitude are associated with the Leadville township.

Assessments were undertaken to determine the level of visual impact for 61 representative non-participating dwellings within 4,950 m. The assessment identified:

- 42 non-participating dwellings within the blue line of visual magnitude would have nil, negligible or low visual impact. This is mainly due to intervening topography or vegetation.
- 16 non-participating dwellings within the blue line of visual magnitude were assessed as having the potential to have moderate visual impacts.
- Three (3) non-participating dwellings within the blue line of visual magnitude were assessed as having the potential for a high visual impact.

Practical and feasible mitigation measures have been proposed for each of the non-participating dwellings with a moderate or high visual impact rating. The proposed mitigation measures would assist in significantly reducing negative impacts resulting from the majority of these dwellings. Mitigation measures in keeping with the existing character include screen planting and supplementary planting of existing vegetation.

1.0 Introduction

1.1 Introduction

Moir Landscape Architecture have been commissioned by UPC\AC Renewables Australia to prepare a Landscape and Visual Impact Assessment (LVIA) for the proposed Valley of the Winds wind farm (referred to hereafter as 'the Project').

The Project includes the construction, operation and decommissioning of a 800 MW wind farm generally comprising wind turbine generators, access tracks, underground cables, overhead transmission lines, on-site substation, potential battery storage facility, and associated operational and temporary accommodation village approximately 7 km southwest of Coolah, New South Wales.

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. 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.

This LVIA has been prepared in accordance with the *Wind Energy: Visual Assessment Bulletin December 2016.* This LVIA forms a part of the Environmental Impact Statement (EIS) to be submitted to the Department of Planning, Industry and Environment (DPIE). This information will assist the community and the DPIE to understand and assess the likely visual impacts.

1.2 Relevant Experience

The Bulletin states *the proponent is expected to engage professionals from relevant natural resource management and design professions (for example environmental planners, geographers, landscape architects, architects, or other visual resource specialists), with demonstrated experience and capabilities in visual assessment to carry out a wind energy project visual assessment.*

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 Assessments. 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 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 LVIAs 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 LVIAs for the following Wind Energy Projects:

- *Liverpool Range Wind Farm Modification* (Coolah, New South Wales)
- *Crudine Ridge Wind Farm* (New South Wales)
- *Bodangora Wind Farm* (Bodangora, New South Wales)
- *Capital II Wind Farm* (Bungendore, New South Wales)
- *Uungula Wind Farm* (Wellington, New South Wales)
- *Lord Howe Island Wind Turbines* (Lord Howe Island, New South Wales)
- *Cherry Tree Wind Farm* (Seymour, Victoria)
- *Lakeland Wind Farm* (Lakeland, Queensland)
- *Hills of Gold Wind Farm* (Nundle, New South Wales)
- *Jeremiah Wind Farm* (Adjungbilly, New South Wales)

2.0 Study Method

2.1 Secretary's Environmental Assessment Requirements (SEARs)

The Project is classified as State Significant Development (SSD) and will be assessed and determined under the provisions of the *Environmental Planning and Assessment Act 1979*.

Secretary's Environmental Assessment Requirements (SEARs) issued in June 2020 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* (DPIE, 2016).

A brief overview of the requirements of the *Wind Energy: Visual Assessment Bulletin for State Significant Wind Energy Development* 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 adopted by the then 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.

The visual assessment process is broken into two main stages: Stage 1: Preliminary Environmental Assessment and Stage 2: EIS. This LVIA responds to the requirements of Stage 2 of the Bulletin.
The Preliminary Visual Impact Assessment prepared for Stage 1 was undertaken by *Green Bean Design* in May 2020 and the findings of the assessment undertaken have been included in this report.

2.3 Overview of the Study Method

In accordance with the Visual Assessment Bulletin, the visual assessment includes:

- a baseline study that includes analysis of the landscape character, scenic quality and visibility from viewpoints of different sensitivity levels;
- establishment of visual influence 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.

Extensive field work and photographic survey work for the study was undertaken in March, May and December 2021 from public and private properties.

2.4 Report Structure

The flow chart on the following page provides a high level overview of the LVIA process utilised to undertake the assessment. ***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

2.5 Landscape and Visual Impact Assessment (LVIA) Process

VISUAL BASELINE STUDY

Comprehensive assessment of the existing landscape character to determine the baseline against which the Project will require assessment against. Input from the community to determine landscape values is integral in this phase.

DEFINE THE VISUAL CATCHMENT

Determine the visual catchment through the use of preliminary assessment tools and GIS mapping to determine the extent of visibility and identify areas upon which to undertake detailed assessment.

KEY VIEWPOINT ANALYSIS

Undertake assessments from key viewing locations identified within the 'visual catchment' to determine the impact of the Project. This includes an assessment from public and private viewing locations.

VISUALISATIONS

The use of visualisation tools (including photomontages and wire frame diagrams) to assist in the assessment of the Project.

OTHER ASPECTS

Assessment of other aspects which have the potential to contribute to the visual impact. This includes: associated infrastructure, cumulative impact from surrounding Projects, shadow flicker and night lighting

SUMMARY AND RECOMMENDATIONS

Summary of the findings of the report and recommendations for reducing the identified impacts.

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.*
VISUAL BASELINE STUDY	***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: Visual Baseline Study	***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*
VISUAL CATCHMENT	***Section 6.0: Preliminary Assessment Tools***	***Visual Bulletin Requirements Addressed:***

	Define the Visual Catchment of the Project:
	• Preliminary Assessment Tools:
	  • Visual Magnitude
	  • Multiple Wind Turbine Effect
		• *Visual Magnitude Assessment: Mapping the dwellings, key viewpoints and proposed turbines at scale to establish the potential visual magnitude.*
		• *Map into six sectors of 60° any proposed turbines and any existing or approved turbines within each dwelling or key public viewpoint.*

	Section 7.0 - Zone of Visibility	***Visual Bulletin Requirements Addressed:***
	• Zone of Visibility (ZVI)	• *Establish the theoretical 'zone of visual influence' of the proposal (the area from which the proposal is theoretically visible or the 'visual catchment').*
KEY VIEWPOINT ASSESSMENT	***Section 8.0: Public Viewpoint Analysis***	***Visual Bulletin Requirements Addressed:***
	Assessment of viewpoints from areas identified within the visual catchment. ***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.*
	Section 9.0: Dwelling Assessment Overview	***Visual Bulletin Requirements Addressed:***
	• Summary of impact on Dwellings ***Refer to Appendix E - Dwelling Assessment***	• *All key public viewpoints and individual dwellings within the 'visual catchment' should be identified and assessed.*
VISUALISATIONS	***Section 10.0: Photomontage & WIre Frame Diagrams***	***Visual Bulletin Requirements Addressed:***
	• Photomontage selection process • Photomontage development process ***Refer to Appendix D - Photomontages & Wire Frame Diagrams***	• *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.*
OTHER ASPECTS	***Section 11.0 Shadow Flicker & Blade Glint***	***Visual Bulletin Requirements Addressed:***
	• Shadow Flicker Assessment (Section 11.1) • Blade Glint Assessment (Section 11.5)	• *An assessment of the number of hours of potential 'shadow flicker'* • *Blade Glint*
	Section 12.0 Night Lighting	***Visual Bulletin Requirements Addressed:***
	• Night Lighting Assessment	• *Consider whether any obstacle lighting required is likely to result in any significant increase in visual impacts.*
	Section 13.0 Cumulative Visual Impacts	***Visual Bulletin Requirements Addressed:***
	• Cumulative Visual Impacts	• *Address potential cumulative impacts of wind energy projects in the region (the wind energy project as well as existing and approved projects).*
	Section 14.0 Associated Infrastructure	***Visual Bulletin Requirements Addressed:***
	• Overview of impact resulting from Associated infrastructure	• *the assessment of visual impacts from all ancillary facilities and infrastructure will be required.*
SUMMARY AND RECOMMENDATIONS	***Section 15.0 Visual Impact on Landscape***	***Visual Bulletin Requirements Addressed:***
	• Overview of LCUs with regards to Visual Performance Objectives • Summary of impact on Landscape Character	• *Assess the Project using visual performance objectives.*
	Section 16.0 Mitigation Methods	***Visual Bulletin Requirements Addressed:***
	• Wind Farm Design • Mitigation Methods for Residences	• *An outline of any mitigation and management options proposed, including consultation with affected property owners regarding the proposed mitigation works*
	Section 17.0 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 Additional Literature

In addition to the Bulletin, the following literature has assisted in the formulation of the study methodology and where relevant have been referenced in the report:

- *Scottish Natural Heritage, Visual Representation of Wind Farms - Good Practice Guidance (February, 2017)*
- *Environment Protection and Heritage Council, Draft National Wind Farm Development Guidelines (July 2010)*
- *Landscape Institute and Institute of Environmental Management & Assessment, Guidelines for Landscape and Visual Impact Assessment Third edition (2013)*
- *Clean Energy Council, Best Practice Guidelines for Wind Energy Development (June, 2018)*

2.7 Policy Considerations

2.7.1 Local Government Policies

The proposal is considered as a State Significant Development (SSD) and will be assessed as such by the NSW DPIE, however relevant local government policies outlined in the Warrumbungle Shire Local Environment plan (LEP) of 2013 have also been considered. The Project is located entirely within the extents of Warrumbungle Shire Local Government Area (LGA) .

2.7.2 NSW Roads and Maritime Services

The assessment of shadow flicker, blade glint and reflectivity is to consider impacts on road users. This has been included in ***Section 11.0*** of this LVIA.

2.7.3 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 12.0*** of this LVIA.

3.0 Project Overview

3.1 The Project Site

The Project is situated in the Central Western Tablelands Region of NSW, within the Warrumbungle Shire LGA between the rural township of Coolah and the Golden Highway. Other surrounding settlements include Leaville and the village of Uarbry. The wind farm site will be located within the Central-West Orana Renewable Energy Zone, recently identified by the NSW Government.

The area's undulating terrain allows for the wind turbines to be sited on ridgelines within cleared agricultural lands that are currently used for livestock grazing. Existing farming practices such as livestock grazing will continue next to the wind turbines, continuing the region's close agricultural connection with the land while also allowing the generation of clean renewable energy for the people of NSW.

Figure 1 illustrates the location and extent of the Project Site.

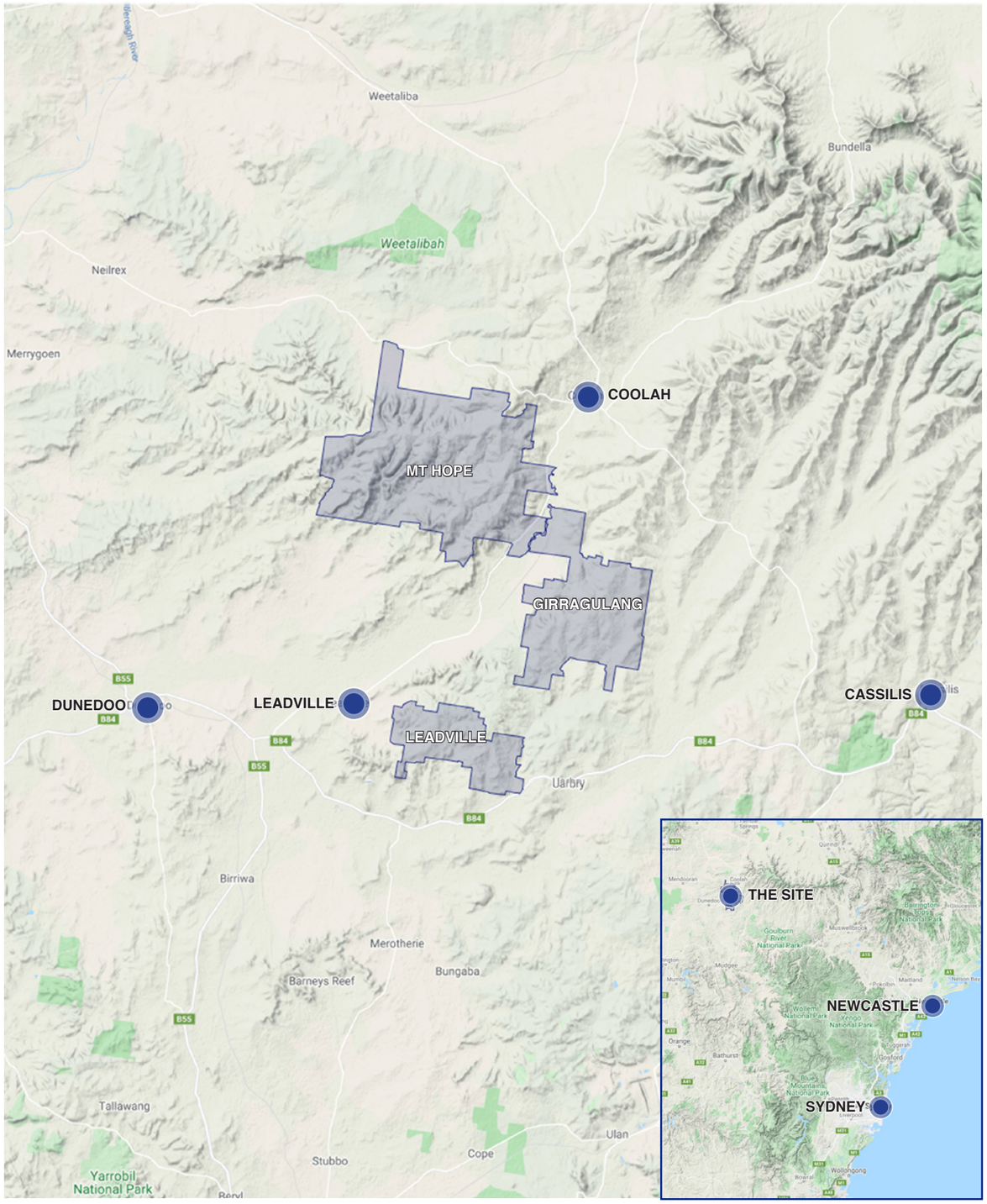


***Figure 1** The Project Site (Map Source: Google Maps)*

3.0 Project Overview

3.2 The Project

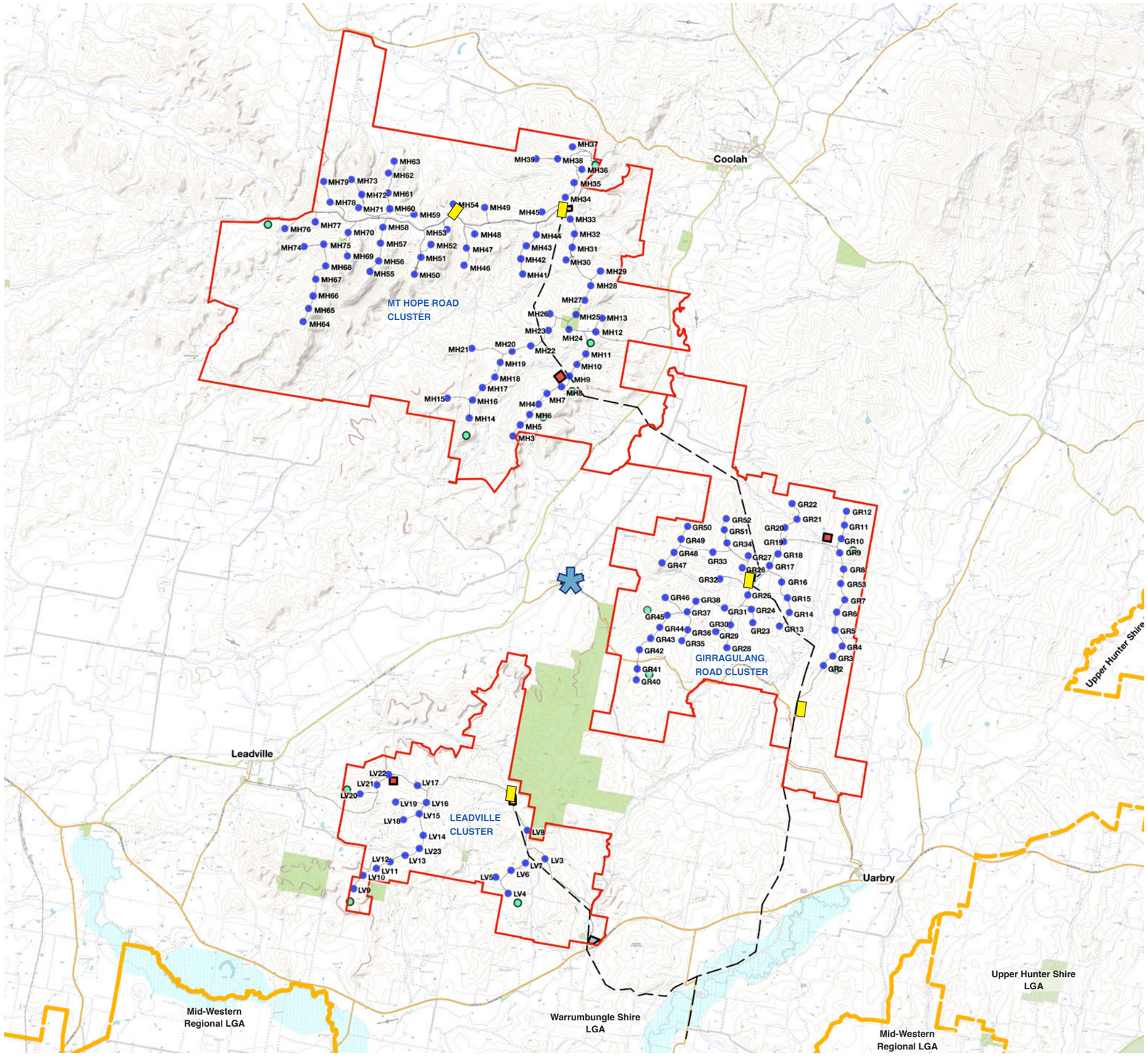
The Project would consist of up to 148 wind turbine generator (WTG) locations with a combined maximum installed capacity of 800 megawatts (MW). It aims at capturing the natural power of the high speed winds that flow through the Coolah Valley in order to generate enough clean energy to power 590,000 homes.

A total number of 148 turbines will be divided amidst 3 clusters. These are the Mount Hope Road cluster (76 turbines), Girragulang Road cluster (51 turbines) and Leadville Road cluster (21 turbines). The three clusters will be linked via a high voltage transmission line in order to produce approximately 800 MW of clean renewable energy each year.

The turbines have a maximum height of 250 metres and will be linked electrically in order to produce approximately 800 MW of clean renewable energy each year. Gravel access tracks would link the turbines and ancillary infrastructure throughout the wind farm site. The wind farm site is located within private property with access via lease agreements with landowners. The turbines and substations will be connected via low voltage underground cables (about 33kV capacity).

Three substations will be located within the extents of each cluster and a step-up facility at the connection to Central-West Orana REZ Transmission line is also being proposed. Overhead transmission lines of upto 220 kV will dispatch electricity from each cluster. A high voltage transmission line of 330 kV will also be required to connect the substation to the National Electricity Market (NEM) which will supply this generated electricity. A battery energy storage system (BESS) may also be required as a part of the electrical infrastructure (UPC\AC Renewables Australia, 2020).

3.0 Project Overview



The Project
Valley of the Winds Wind Farm

LEGEND:

- Project boundary
- LGA Boundary
- MH77 WTG locations
- Access tracks
- Proposed Transmission line
- Proposed Substation
- Meteorological Masts
- Proposed location for temporary workers accommodation village
- Site compounds (TBC)
- Potential quarry sites
- NPWS Reserve / State Forest
- Rivers & creeks
- Major roads / Highways
- Minor roads

N

0 2 4 6 8 10km

***Figure 2** The Project (Map Source: Six Maps)*

3.0 Project Overview

3.3 Wind Turbine Design

The proposed turbines selected for the Project has not yet been confirmed, this report considers a maximum blade tip height of 250 metres as a worst case scenario.

- A generating capacity of 6 MW;
- a 4-7 part tubular steel tower holding the nacelle;
- three blades mounted to a rotor hub on a tubular steel tower, with a combined height of blade and tower limited to a maximum tip height of 250 m AGL;
- a gearbox and generator assembly housed in a nacelle; and
- adjacent hardstands for use as crane pads and assembly and laydown areas.

Table 2 provides an overview of dimensions of the turbine components that have been used for this assessment. To best represent a worst case scenario, the maximum hub height of 160 metres has been used for modelling and visualisation purposes in this report. ***Figure 3*** illustrates the turbine parameters utilised for this report. ***Image 1*** shows the appearance of a typical wind turbine.

Wind Turbine Components		
Project Component	***Dimensions used in LVIA:***	***Quantity***
Uppermost Blade Tip	250 metres AGL	***148***
Tower (hub) height	160 metres	
Blade length	90 metres (including nacelle)	

Table 2 Wind Turbine Dimensions for Visual Assessment

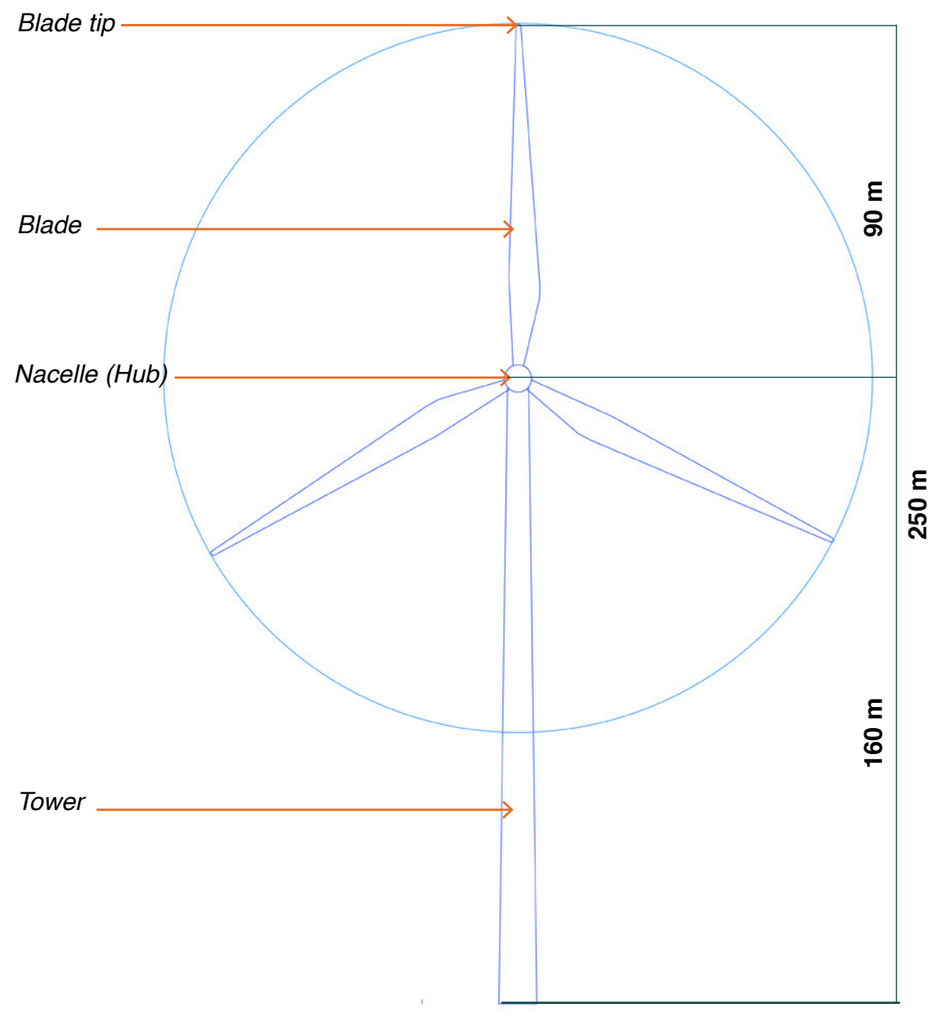


Figure 3: Turbine Dimensions used for Visual Assessment

3.0 Project Overview

3.4 Associated Infrastructure

In addition to the turbines, the following provides an overview of the permanent associated infrastructure components proposed for the Project which may contribute to the visual impact of the proposal. An overview of the assessment of the potential visual impacts resulting from the associated infrastructure has been provided in ***Section 14*** of this report.

Associated Infrastructure	
Project Component	***Description***
On-site substations	Each cluster, i.e., the Mount Hope cluster, Girragulang cluster and Leadville cluster will be connected to a substation as shown in Figure 2.
Underground Reticulation Lines	Underground electrical reticulation lines of 33 kV capacity will connect the wind turbines to the substations in each cluster.
Overhead Transmission Lines	Overhead transmission lines of 330 kV capacity will dispatch electricity from each cluster and connect to the high voltage transmission line.
High Voltage Transmission Line	High voltage transmission line of 500 kV capacity will connect the entire wind farm to the overall grid through the Central-West Orana Transmission line.
Operations and Maintenance Facility	Permanent facilities will be constructed.
Meteorological monitoring masts	Up to 13 meteorological masts are proposed with a maximum height of up to 150 m.
Access Track Network	Access and egress points from each cluster will arise from all public roads. All operational access tracks and associated infrastructure will be located on private property.

Table 3 Associated Infrastructure

The following temporary elements will be required during construction of the Project:

- construction compounds;
- laydown areas;
- concrete batching plants;
- temporary workers accommodation village; and
- quarry sites for construction material (rock for access tracks and hardstands).

3.0 Project Overview

Image 1 Typical Wind Turbine Design (Gullen Range Wind Farm)

Image 2 Typical Substation (Source: NGH)

Image 3 Crane Hardstand Area (Source: NGH)

Image 4 Transmission Line (Source: NGH)

Image 5 Operations and Maintenance Facility (Source: NGH)

4.0 Community Consultation

4.1 Community Consultation Process

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.

The Proponent consulted with the community on the preliminary project boundary to gather feedback and an understanding of the key landscape features, areas of scenic quality and key public viewpoints. The community feedback has been reflected in the Visual Baseline Study that informs this LVIA.

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 5.5***) 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 Perception & Results from Social Impact Assessment

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

A CSIRO study published in 2012: *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.

The likely changes to the visual landscape were identified throughout community engagement as a key consideration of the project. The primarily concern related to an increase of built infrastructure and associated changes to the rural character of the landscape and the how this would affect how people experienced their surroundings, as well as their lifestyle choices.

The impact varied between stakeholder groups with some nearby neighbours fearing that the size of the turbines would detract from the natural landscape – something that they highly valued and was a primary consideration for moving or remaining in the area. Some host landholders also expressed concerns over the look of the turbines and what they would potentially see from their properties, while others were more concerns about how they would be physically placed.

"I won't necessarily see the ones on my property, but I will see the ones towards Mount Hope Cluster"

"They (the turbines) can be beautiful and majestic but 148 is a lot and if they were all crammed in a row it would be 'dead ugly'.

Generally, the impact of wind turbines on the visual landscape is a very subjective matter with perspectives differing depending on location, local context and place attachment. Some individuals enjoy seeing wind turbines in the landscape, while others find them unappealing. The wider community including business and community groups, had a lower level of concern, with some suggesting that the turbines could attract tourist to the area or provide a change in scenery for road users.

Visual impacts is regularly raised on comparative wind projects across NSW as evidenced by a review of the submissions report for the nearby Liverpool Ranges Wind Farm and the scoping report of Barneys Reef Wind farms. Transgrid also carried out engagement between December 2020 to September 2020 about the Central West Orana Rez who also heard from many people that they were concerned that their views or outlook could be affected by the lines and towers associated with new infrastructure.

A small number of respondents to the random survey also noted the cumulative impact of a number of renewable energy projects in the area were negatively affecting the views in rural NSW. The cumulative impacts of the Project have been assessed in **Section 13.0** of this report.

5.0 Visual Baseline Study

5.1 Visual Baseline Study

In accordance with the Bulletin: *A visual baseline study must be undertaken to establish the existing landscape and visual conditions. This forms the basis of determining the level of impacts of a proposed wind energy project. The baseline study is prepared and evaluated by the proponent prior to undertaking any visual analysis.*

A Preliminary Visual Impact Assessment (PVIA) was undertaken by *Green Bean Design Landscape Architects Pty Ltd* as part of Stage 1: Preliminary Environmental Assessment (pre-lodgement). In accordance with the Bulletin a preliminary landscape baseline study was prepared. Moir LA have developed upon the study undertaken in the PVIA to provide a detailed baseline study for the LVIA.

In accordance with the Bulletin, the baseline study should consider the following inputs in the 'visual catchment' for the project:

- *elements of the landscape important to the community, including public and private viewpoints;*
- *the sensitivity of the viewers who use those viewpoints, and the distances at which they may view the landscape and potential wind turbines and other ancillary facilities;*
- *the character of the landscape involved, its key features and the relative scenic quality of the area; and*
- *the location of any existing operational or approved wind energy projects within both a regional and local context, including any nearby surrounding wind energy projects within eight kilometres which may have the potential to create direct or indirect visual impacts between the proposed and any other operational, approved or proposed wind energy projects.*

The purpose of the Visual Baseline Study is to establish the existing landscape and visual conditions through descriptions, mapping and photographic representations. The study method for undertaking the Visual Baseline Study has been established in accordance with ***Appendix A of the Bulletin*** where relevant and in conjunction with previous experience on large scale wind energy projects.

Table 4 provides an overview of the methodology used to establish a quantitative approach to defining and assessing the landscape character.

Visual Baseline Study Inputs:	
Sensitive Land Use Designations	
• *Map Layer identifying National and State Sensitive Land use Designations and LEP Zones.*	***Refer to Section 5.2 and 5.3***
Landscape Character Type	
• *Describe the broad area of land in which the wind energy project is located.*	***Refer to Section 5.4***
Key Landscape Features	
• *Identify areas of visual interest or quality that stand out visually in the landscape.*	***Refer to Section 5.5***
Landscape Character Unit Classification	
• *Landscape is categorised into Landscape Character Units (LCU) and Scenic Quality Ratings are applied to each LCU.*	***Refer to Section 5.6 and Appendix B***
Viewpoint Inventory and Sensitivity Levels	
• *Undertake a viewpoint inventory from public and private locations and establish the Visual Influence Zones for each.*	***Refer to Section 8.0***
Visibility Distance Zones	
• *Undertake visibility or view shed mapping when assessing what may be visible from a given viewpoint looking in all directions.*	***Refer to Section 7.0***

Table 4 Visual Baseline Study Inputs

5.0 Visual Baseline Study

5.2 Sensitive Land Zoning Designations

The Project Area is located within the Warrumbungle Shire Local Government Area. The following provides an overview of the land use zoning within the Project and its immediate surrounds as shown on ***Figure 4***.

5.2.1 RU1 Primary Production

The Project Area and surrounding land is predominately zoned ***RU1 - Primary Production*** under the Warrumbungle Shire LEP. The objectives of the RU1 zoning relevant to landscape and visual impact within this LEP is *'to encourage sustainable primary production; minimise fragmentation and alienation of resource lands; and encourage diversity in primary industry enterprises and systems appropriate for the area'*.

5.2.2 C1 National Parks and Nature Reserves

Land parcels located north and southeast of the Project Area have been zoned as C1 - National Parks and Nature Reserves. These include:

- Weetalibah Nature Reserve
- Durridgere State Conservation Area

Land in these areas are reserved under the *National Parks and Wildlife Act 1974* to protect their environmental significance. This LVIA has referred to the Guidelines for development adjoining NPWS lands for general information on NPWS's expectations in relation to development that has the potential to impact NPWS lands. All potential impacts on the conservation values of the surrounding National Parks and NPWS management of these parks should be avoided.

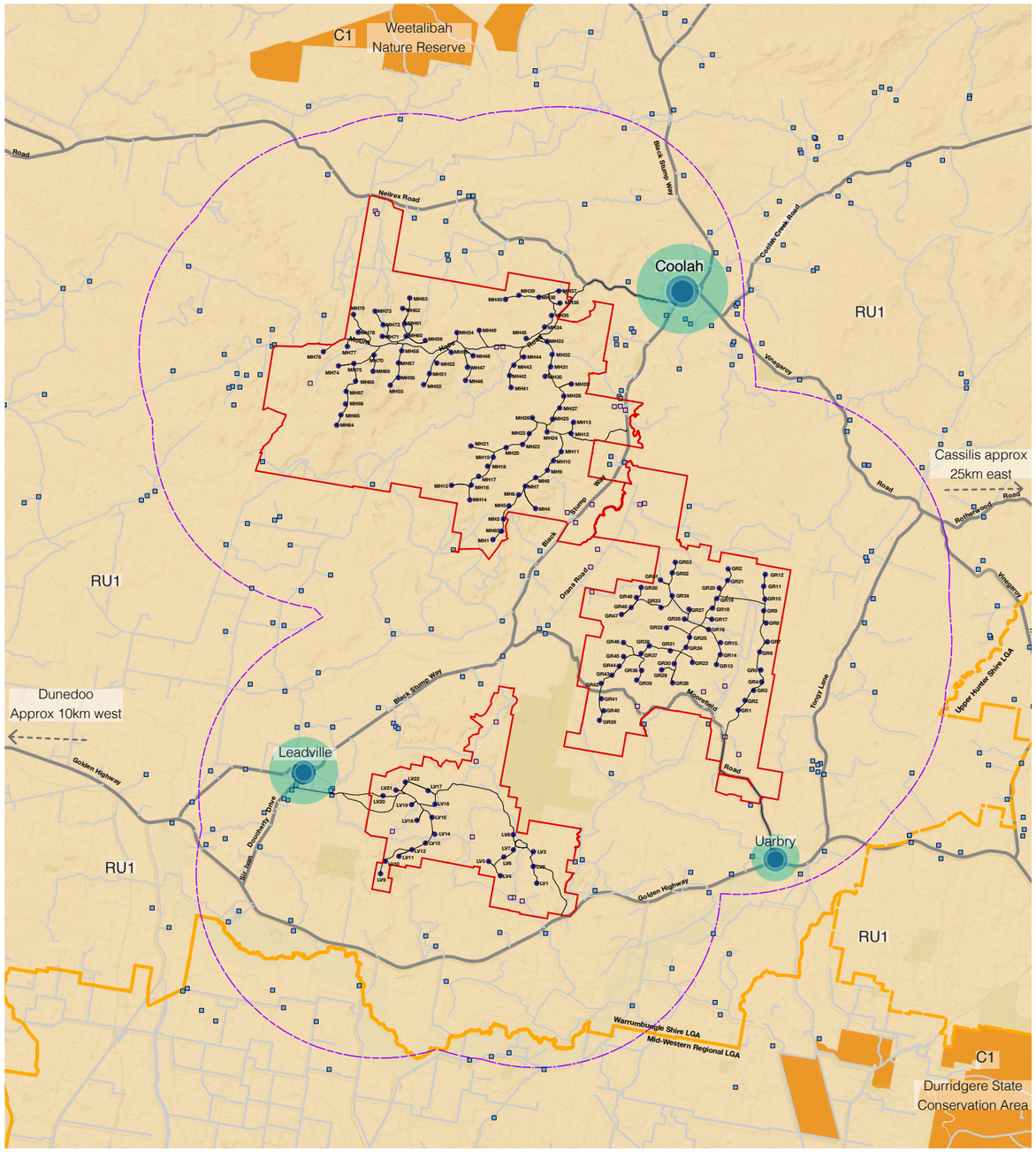


***Figure 4* Land Zoning Designations Within The Study Area**
(Source: Warrumbungle Shire LEP, Upper Hunter LEP, Mid-Western Regional LEP)

5.0 Visual Baseline Study

5.3 Sensitive Land Use Designations

Land use within the Project Area is predominantly dedicated to agricultural purposes, specifically cattle and sheep grazing. Dryland cropping is also evident within the Project Area. Areas of minimal use that exist within and in the immediate surrounds of the Project Area includes land parcels that are rich in biodiversity. Surrounding land uses are dominated by agricultural activity, especially dryland cropping and modified grazing pastures. The following section provides an overview of the land uses as shown in ***Figure 5***.

5.3.1 Agricultural lands

The majority of the land parcels located within the southern-most and middle section of the Project Area are dedicated to grazing pastures with native and modified vegetation. A few parts of the southern and northern portion of the Project Area are categorized as 'minimal use' in order to limit encroachment onto the rich biodiversity identified in these areas (NSW Department of Planning, Industry and Environment, 2017).

5.3.2 Nature Conservation & Minimal Use

These areas coincide with those zoned as ***C1-National Parks and Nature Reserves***. A few parcels categorised as minimal use are located within and in immediate surrounds of the Project Area. Vegetation in these areas includes dry sclerophyll and shrubby woodlands that form a part of conserved native bushland.

5.3.3 Rural towns and villages

The closest settlements that lie within the 7 km radius of the Project Area are Coolah, Leadville and Uarbry. Dunedoo and Cassilis are located on the Golden Highway approximately 10-20 km from the Project Area.

Dwellings are mainly concentrated around Coolah and the village of Leadville. Uarbry is a small locality that comprises of 5 dwellings located on the Golden Highway. Many dwellings are scattered along important transport corridors such as the Black Stump Way, Golden Highway, Vinegaroy Road, Neilrex Road and Tongy Lane. A number of scattered rural residential dwellings are situated across the Project Area and these can be accessed by minor roads that emerge from major highways and roads.

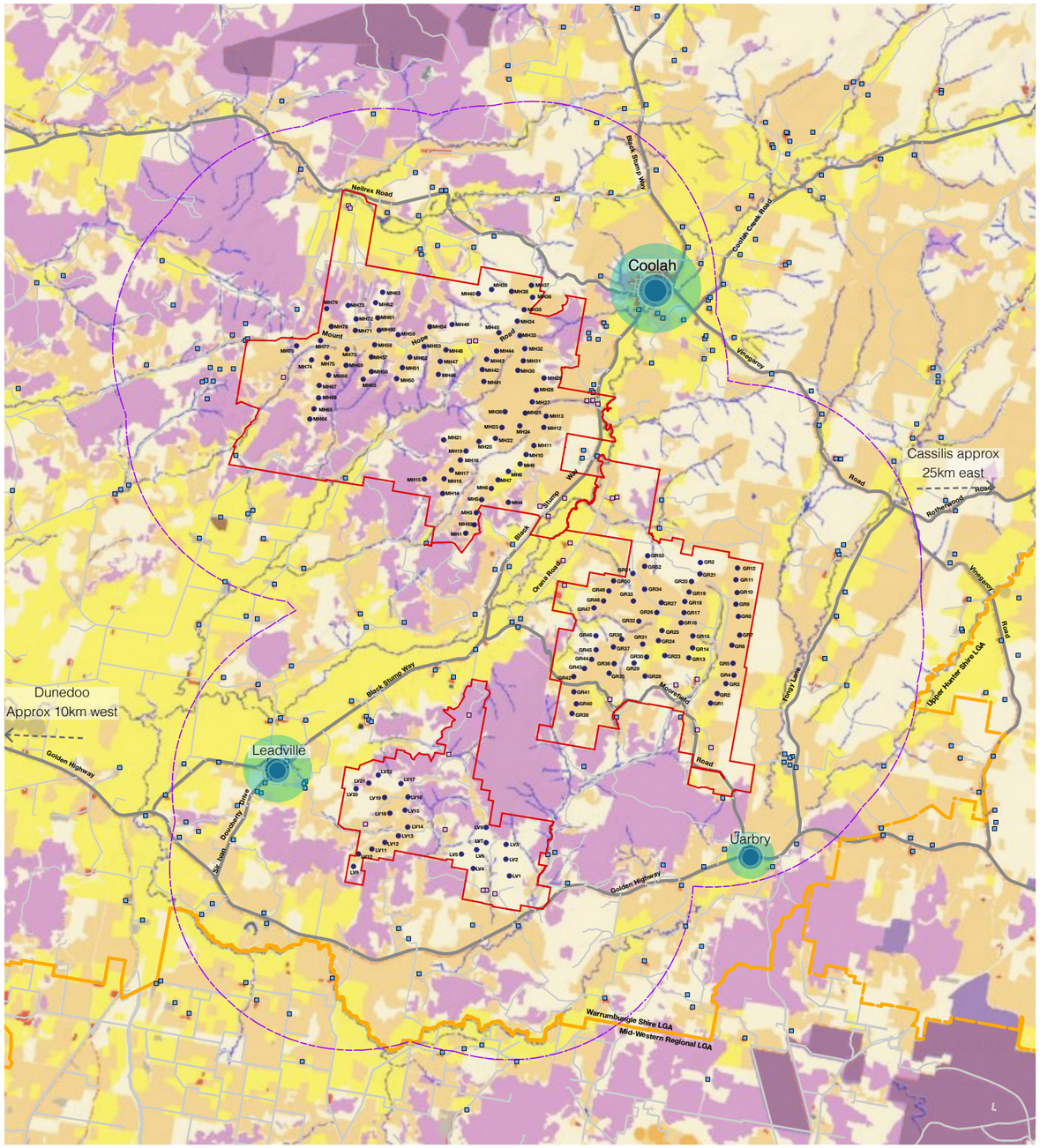


***Figure 5* Land Use Designations Within The Study Area**
(Map Source: environment.nsw.gov.au/eSpade, NSW Landuse Mapping 2017)

5.0 Visual Baseline Study

5.4 Overview of Bioregion

The Project is situated at the junction of three different Bioregions of NSW as shown in ***Figure 6***. The Brigalow Belt South Bioregion's character is prevalent across the Mount Hope and Girragulang Road clusters. The Leadville cluster is spread across the Sydney Basin Bioregion and the Southwestern Slopes Bioregion. The landscape character around these three clusters, however, is in unison with the broader landscape character of the region.

The area's topography is represented by gently sloping to steep undulations with dry sclerophyll and shrubby woodlands dominated by Yellow Box, Grey Box, varieties of Ironbarks and Red Gums (NSW Department of Primary Industries and Environment, 2016). In some areas rocky hills with undulating slopes prevail with wide valley floors and flooplains. Ridgelines are dominated by thin stony loams and clay soils along slopes in this predominantly basalt country. River valley floors possess textured deeper sands and brown earths (NSW Department of Primary Industries and Environment, 2016). Overall, the deep, well-structured clays with high nutrient values that support the dominant agricultural activity in the region (NSW Office of Environment and Heritage, 2018).

Hilly terrains that emerge from the Liverpool Range are dominated by open woodlands of White Box (*Eucalyptus albens*), Yellow Box (*Eucalyptus melliodora*) and Blakely's Red Gum (*Eucalyptus blakelyi*) on the upper and mid slopes (Murphy et. al., 1998). Vegetation communities around Talbragar Valley include Narrow-leaved Ironbarks (*Eucalyptus crebra*), White Cypress Pines (*Callitris glaucophylla*), Hill Red Gums (*Eucalyptus camaldulensis*) on slopes and Rough-barked Apple (*Angophora floribunda*) and Grey and Yellow Box communities on valley floors (Murphy et. al., 1998). The bioregions support a vast variety of threatened flora and fauna species that thrive on the grassland and woodland habitats in the region.

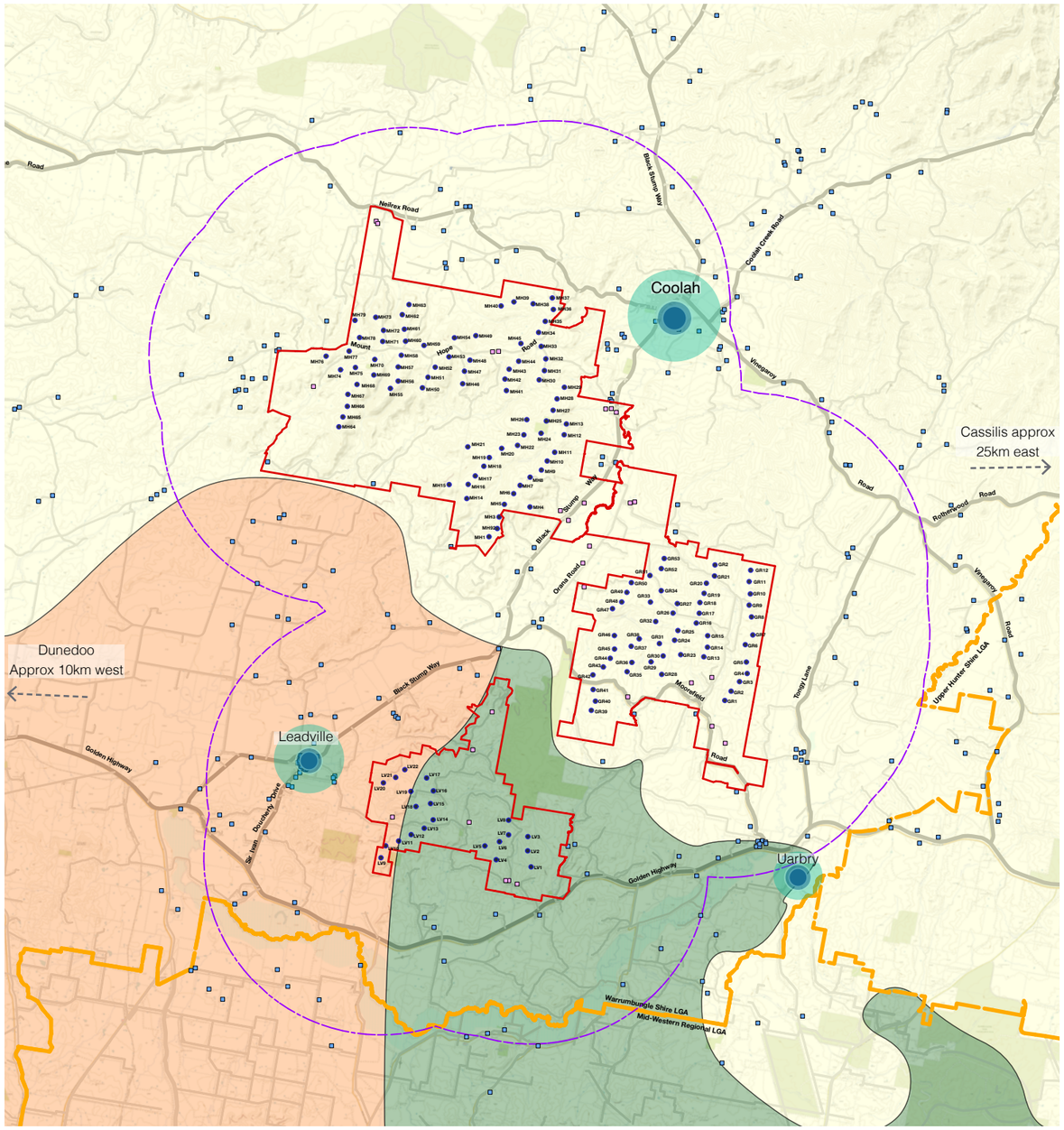


***Figure 6* Overview of Bioregions Around The Study Area**
(Source: NSW Department of Primary Industries and Environment 2016)

5.0 Visual Baseline Study

5.5 Existing 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 Project Area and its surrounding area (the Study Area). The following section of the LVIA describes the typical landscape character of the Study Area.

5.5.1 Nearby Towns and Villages

The Project is located within the Warrumbungle LGA. Settlements in closest proximity to the Project Area are Coolah and Leadville. Uarbry is a locality comprising of 5 dwellings located on the Golden Highway. Dunedoo is located about 10km west and Cassilis is about 20 km to the east of the Project Area.

Coolah:

Coolah lies closest to the northernmost cluster of wind turbines near Mount Hope. The town was established to support agricultural activity in the region in 1840 and it continues to serve the same function. About 1290 people live in Coolah as per the 2016 Census (ABS, 2016) and it is the biggest town that is in closest proximity to the Project Area. The town is located on Black Stump Way and serves as an important stopover / resting spot for commuters (refer to *Image 6*).

Leadville:

Leadville is a small settlement with a population of 186 people (ABS, 2016). The town was formerly known for its associations with the Mount Stewart Mine, the remains of which still exist near the town. Mining occurred in phases in this area between 1888-1894, 1913-1935 and 1950-1952. Currently the town is recognised for its low density rural residential living with large paddocks and sheep and cattle grazing over native and modified pasture lands. It is located closest to the southernmost cluster of wind turbines.

Uarbry:

Uarbry is a village consisting of a cluster of approximately 5 dwellings is located at the intersection of Moorefield Road and Golden Highway in close proximity to the Project Area. As per the 2016 Census, the locality had a population of 49 people (ABS, 2016). Since the 2016 Census, bushfires have destroyed the villages amenities and dwellings. Very few dwellings have been rebuilt since the bushfires which has left the village with only 5 dwellings and no amenities.

Image 6. Character of Coolah's town centre defined by low density ground storey buildings and wide roads

Image 7. Character of grazing lands along Mount Hope Road

Image 8. Modified and native grazing pastures with scattered vegetation along Neilrex Road

5.0 Visual Baseline Study

5.5.2 Accessibility

Major roads that connect all the towns in the region are the Golden Highway which runs east-west and Black Stump Way which runs northeast-southwest. These roads play a very important role in linking Coolah and other settlements in the region to surrounding towns such as Dunedoo, Cassilis, Merriwa and other towns that lie within a 25 km radius. These roads receive heavy volumes of traffic.

Low-use roads that arise from these major roads provide access to dwellings via Mount Hope Road, Moorefield Road, and Sir Ivan Dougherty Drive. Most of these roads are unsealed. Numerous unsealed roads turn off from Moorefield Road and Mount Hope Road to provide access to isolated dwellings.

5.5.3 Landform

The Project Area is situated southwest of the Liverpool Range on the Tertiary Basalt of the Merriwa Pleateau. Ridgelines generally run diagonally from northeast to southwest emerging from the Liverpool Ranges where the Coolah Tops National Park is situated. The landform is characterized by gently rolling to moderately steep undulations that range from 500-800m in elevation and 5-20% incline (NSW Office of Environment and Heritage 2018). The undulating landform generally falls south-southwest around Leadville and Uarbry. The land is studded with hills and peaks that have agricultural associations.

5.3.4 Vegetation

Consistent with the Brigalow Belt South Bioregion's characteristics, native vegetation within and around the Project Area is dominated by fairly healthy dry sclerophyll and shrubby woodland with grassy understorey which has mostly been cleared or slashed to encourage grazing. Prominent tree species are varieties of ironbarks, white box, yellow box and kurrajong trees with the occasional appearance of forest red gums and river oaks along lower slopes and valley floors (Murphy et. al. 1998).

Common understorey species include kanagaroo thorn, cough bush, wire grasses, tall windmill grass, snow grass and speargrasses. Boggy areas are dominated by rushes and short-haired plume grass in drier areas. Grasses are mostly cleared or slashed to support grazing over native and improved pastures (NSW Office of Environment and Heritage 2018).

5.5.5 Water Form - Rivers and Creeks

Creeks and rivers that drain the basalt plains provide limited irrigation to the cropping on fertile soils along the valley. Most of these drainage lines are incised and occasionally convergent, following the northeast-southwest direction which is laid out by the ridgelines (Department of Mineral Resources

Image 9. Dense native vegetation corridors along Narangarie Road

Image 10. Typical dense screening and windbreak plantations on lots along Marombi Road

Image 11. Dense vegetation along Moorefield Road

2002). Drainage lines and roads follow the directions offered by this topography. Important rivers and creeks in the area are Coolaburragundy River and Talbragar River, Rocky Creek, Cainbil Creek, Turee Creek and Mumbedah Creek amidst others.

The Coolaburragundy and Talbragar Rivers are important waterways that feed into a number of gullies and creeks in the area. Coolaburragundy River is a perennial stream and a tributary of the Talbragar River. They both rise from the Liverpool Range and meet in Leadville. Coolaburragundy River carries enough water to support dryland cropping which is prominent in the region (Murphy et. al., 1998). Talbragar River is another perennial steam which is an important waterway within the Macquarie catchment. Its course runs for a distance of 277 kilometeres until it meets Macquarie River near Dubbo (NSW Office of Environment and Heritage, 2018).

5.6 Key Landscape Features

The Bulletin states: *Key landscape features should be identified and shown on the baseline study map for further reference. Key landscape features may include natural features such as a distinctive mountain peak or hill top, a large rock outcrop or cliff, a waterfall, a visually distinctive stand of trees, or even a single large tree that stands out visually in the scene.*

The following provides an overview of the key features identified within the Study Area and its surrounds which contribute to the visual character of the landscape (refer to ***Figure 7).***

5.6.1 High points within the landscape

The Project Area and its surrounds are characterized by undulating hills with elevations ranging from 500-800m. It is also studded with high points that are rocky outcrops or reminiscent of the basalt Merriwa Plateau with agricultural associations. Tourism associations have not been identified in the area. Some of the high points that prevail in the region are Salisbury Hill, Bald Hill, Paddys Knob and Dungeon Cave.

5.6.2 Weetalibah Nature Reserve

This Nature Reserve is located approximately 10km north of the Project Area. The area protects a remnant portion of the once widely spread habitat of narrow leaved iron bark white-cypresses, broad-leaved iron bark and tumble down gums (NPWS, 2021).

Image 12. Landscape character near Tongy Lane defined by vegetated road corridors with limited views of surroundings

Image 13. Open pastures and patchy to sparse corridor vegetation along Black Stump Way

Image 14. Views along Birkalla Road that look towards the Talbragar River valley and surrounds

5.0 Visual Baseline Study

5.6.3 Durridgere State Conservation Area

Durridgere State Conservation Area is located 20 km southeast of the Project Area. It was formerly a part of the Turill State Forest and exhibits typical characteristics of the Brigalow Belt South Bioregion. Predominant species include Narrow-leaved Ironbarks, Red Stringybarks, Spotted Gums, Blakey's Red Gum, Smooth-barked Apple and Scribbly Gums. The area is an important habitat for threatened bird species and mammals. The area was extensively logged and used for timber-getting (NPWS, 2014).

5.6.4 Other conservation areas and vegetation patches

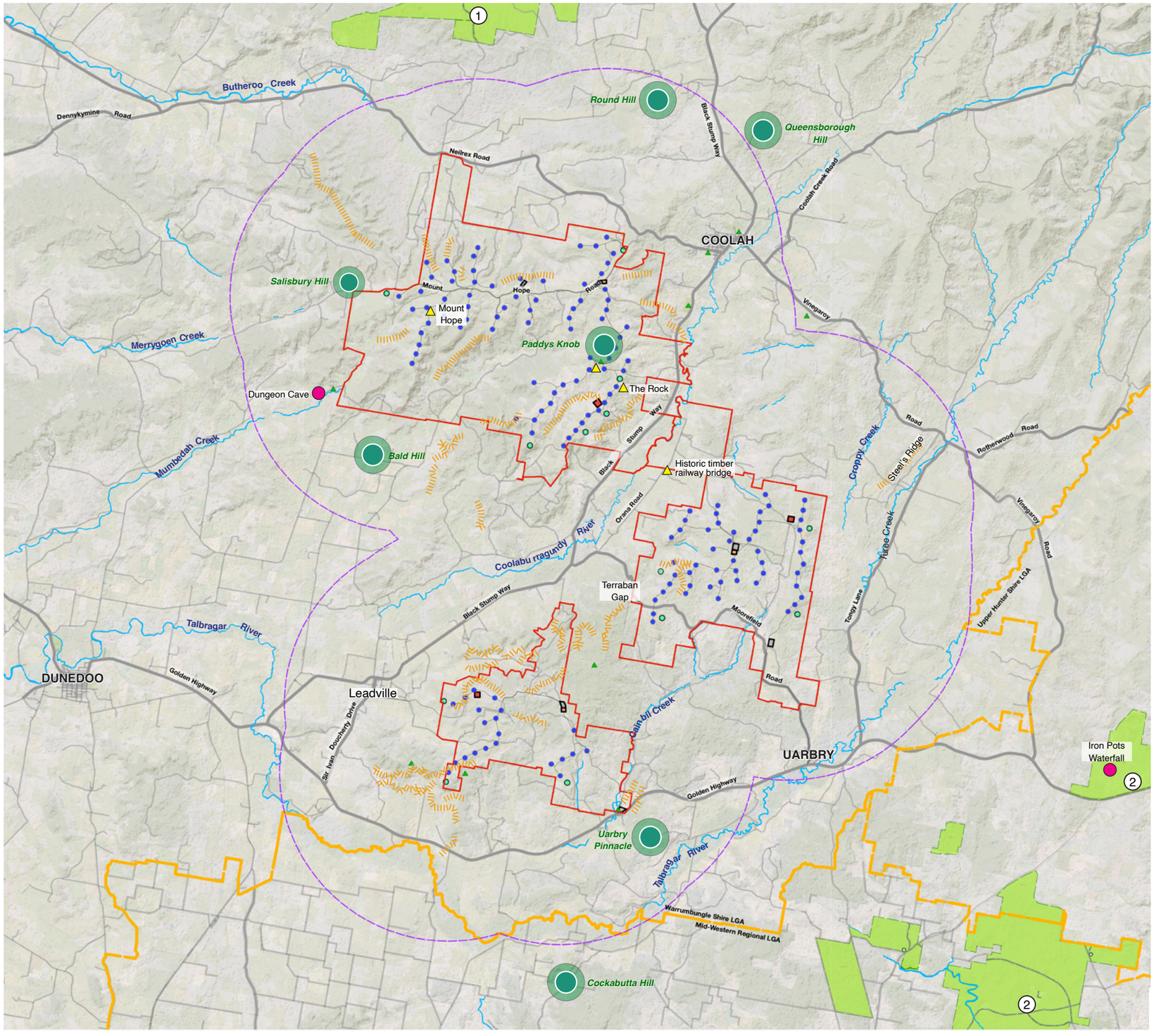
Remnant patches of significant native vegetation are interspersed in areas south of Black Stump Way and north of Golden Highway as well as around the town of Coolah. These green patches exhibit typical Brigalow Belt south Bioregion characteristics with dry sclerophyll vegetation that is spread on gently undulating rises that range from 300-500 m in elevation.

Image 15. Agricultural activity associated with rural residential dwellings in the area

Image 16. Vegetation patches associated with foothills of the Liverpool Range as viewed along Golden Highway

Image 17. Low to gently undulating plains in Uarbry

5.0 Visual Baseline Study



Key Landscape Features and Viewpoints

LEGEND:

- Project boundary
- LGA Boundary
- 8000m from turbines
- WTG locations
- Participating residence
- Non-Participating residence
- 8000m from turbine
- Indicative Ridgeline
- National Park / Nature Reserve
- State Forest
- Parks / Area of natural significance
- Historic / Culturally significant locations
- High points
- Other Points of Interest
- Rivers & creeks
- (1) Weetalibah Nature Reserve
- (2) Durridgere State Conservation Area

N

0 2 4 6 8 10km

***Figure 7** Key Landscape Features (Map Source: ESRI Aerial Imagery)*

5.0 Visual Baseline Study

5.7 Scenic Quality Class Rating

The Bulletin states: *the baseline study inputs, including key landscape features and sensitive land use designations, should lead to the identification of Scenic Quality Classes. 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.*

In accordance with the Bulletin, a Scenic Quality 'frame of reference' has been formulated by Moir Landscape Architecture (***Table 5***) utilising *An approach to landscape sensitivity assessment* by Natural England. The frame of reference developed for Valley of the Winds Wind Farm is in keeping with the example frame of reference provided in the Bulletin.

Each category of the 'frame of reference' has been quantified for each Landscape Character Unit (summarised in ***Section 5.8*** and overviews provided in ***Appendix B)*** to determine a Scenic Quality Rating of **low**, **moderate** or **high.** The resulting *Scenic Quality Rating* is used to assist in defining the Visual Influence Zones in accordance with the Bulletin (refer to matrix in ***Appendix A***).

SCENIC QUALITY RATING		
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 5 Scenic Quality Class Rating Frame of Reference

5.0 Visual Baseline Study

5.8 Landscape Character Unit Classification

Due to the large scale of the Study Area and varying landscape character the Study Area has been categorised into five (5), *Landscape Character Units* to assist in the assessment.

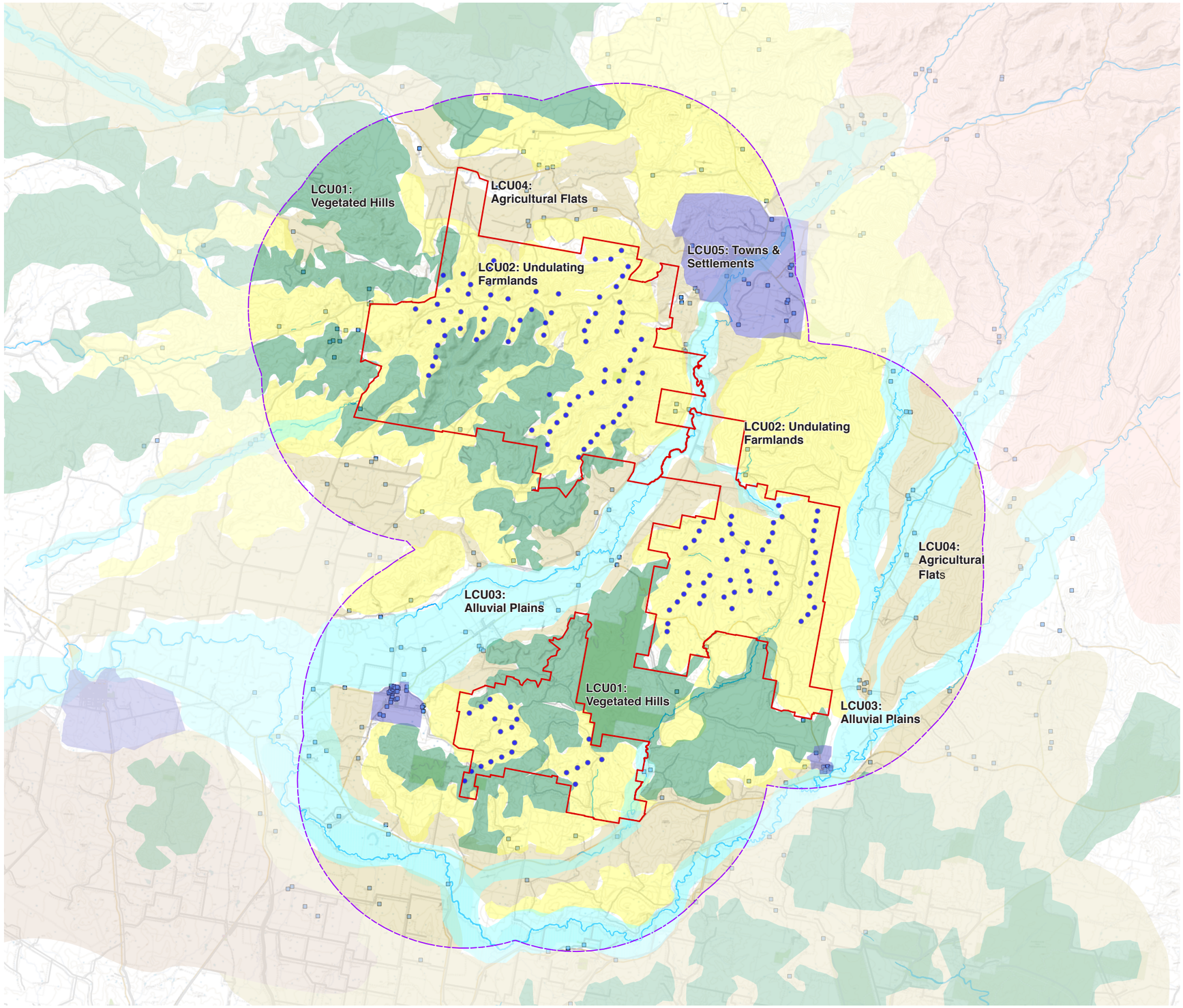
The Landscape Character Units (LCU) are classified by slight variations in the landscapes geology, topography, land use and vegetation which create distinct character areas within the Study Area. The LCUs have been informed by the *Preliminary Landscape and Visual Assessment by Green Bean Design Pty. Ltd.*, land use patterns, vegetation coverage, topographical maps, site images and site inspection.

The general extent of the LCUs are shown on ***Figure 8*** on the following page and detailed description of each Landscape Character Unit has been included in ***Appendix B*** of this report. The Scenic Quality 'frame of reference' has been applied to each LCU (refer to ***Table 6***).

Overview of Landscape Character Units		
LCU:	***Overview:***	***Scenic Quality Rating:***
LCU01 Vegetated hills	Steep ridges and undulating hills with densely vegetated hill slopes that are spread across the Project Area.	**Moderate** *Refer to Appendix B1*
LCU02 Undulating farmlands	Gently undulating landscapes with scattered woodlands that have been partially cleared to support grazing and other agricultural activity.	**Moderate** *Refer to Appendix B2*
LCU03 Alluvial plains	Level, broad floodplains and alluvial terraces that have been cleared to support agricultural activity within the vicinity of the Coolaburragundy and Talbragar Rivers.	**Low** *Refer to Appendix B3*
LCU04 Agricultural flats	Generally flat, cleared land parcels adjacent to alluvial terraces that are utilised for low density living, grazing and cropping.	**Low** *Refer to Appendix B4*
LCU05 Towns and settlements	Highly modified landscape settings that have been adapted for human settlement and activity.	**Low** *Refer to Appendix B5*

Table 6. Overview of Landscape Character Units

5.0 Visual Impacts on Landscape Character



Landscape Character
Valley of the Winds Wind Farm

LEGEND:

- Project Boundary
- Proposed 250m Turbine Location
- Participating Dwellings
- Non-participating Dwellings
- 8000m from turbine
- Roads
- LCU01: Vegetated Hills
- LCU02: Undulating Farmlands
- LCU03: Alluvial Plains
- LCU04: Agricultural Flats
- LCU05: Towns & Settlements
- Rivers & Creeks

N

0 2 4 6 8 10km

***Figure 8** Landscape Character Units (Map Source: Six Maps)*

6.0 Preliminary Assessment Tools

6.1 Overview of Preliminary Assessment Tools

To assist in defining the visual catchment, preliminary assessment tools have been developed in the Bulletin. In accordance with the Bulletin, the purpose of the preliminary assessment tools are: *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.*

The preliminary assessment tools involve analysis of two key visual parameters:

1. Visual Magnitude (***Refer to Section 6.2***)
2. Multiple Wind Turbine Tool (***Refer to Section 6.4***)

Once defined, the Bulletin states: *Further assessment and justification for placement of turbines located in these sensitive areas in the EIS will be required, along with a description of mitigation and management measures being employed to reduce impacts. This assessment may identify that factors such as topography, relative distance and existing vegetation may minimise or eliminate the impacts of the project.*

Dwellings identified through the application of the Preliminary Assessment tools have been assessed in detail in ***Appendix E*** of this LVIA.

6.2 Preliminary Assessment Tool 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 9***.

In accordance with the Bulletin: ***proposed turbines below the black line must be identified along with the dwellings or key public viewpoints as part of the request for SEARs.*** The proposed wind turbines are based on a worst case scenario with a tip height of ***250 metres***. The 'black line 'intersects at a distance of ***3,350 metres*** and the 'blue line' intersects at ***4,950 metres***.

For the purpose of the Preliminary Assessment, the Visual Magnitude thresholds are based on a 2D assessment of the Project alone. Further assessment indicates factors such as topography, relative distance and existing vegetation may minimise or eliminate the impacts of the project from residences.

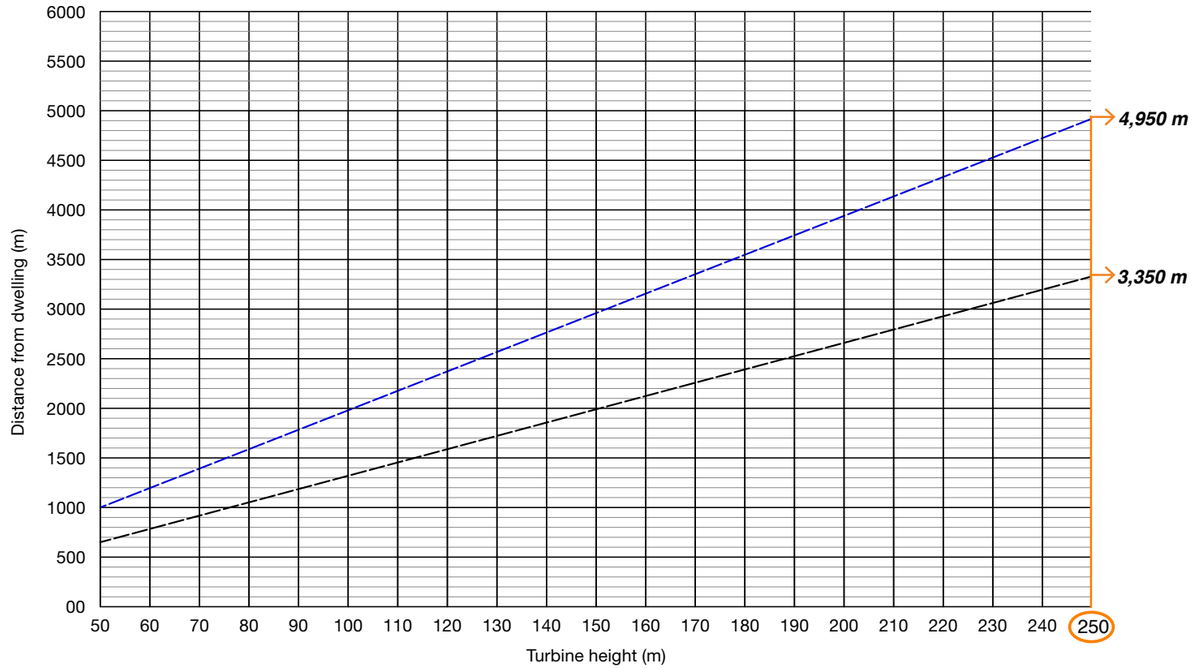
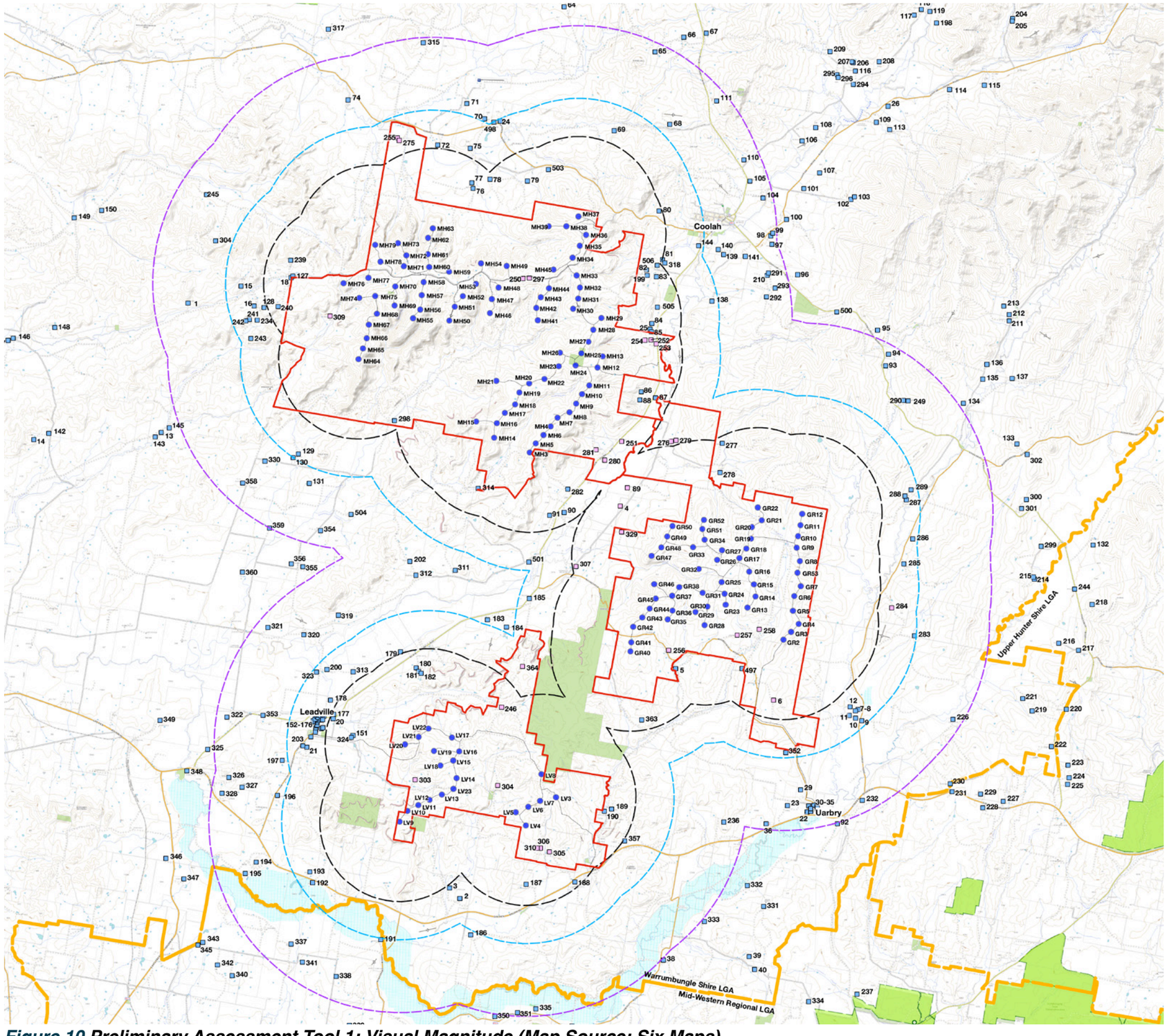


Figure 9 Visual Magnitude thresholds for Project Layouts (Source: Visual Assessment Bulletin)

6.0 Preliminary Assessment Tools



Visual Magnitude

Valley of the Winds Wind Farm

LEGEND:

- Project Boundary
- MH77 Proposed 250m Turbine Location
- Participating Dwelling
- Non-participating Dwelling
- LGA Boundary
- 3350m from turbine
- 4950m from turbine
- 8000m from turbine
- Major roads / highways
- Minor roads
- NPWS State Reserve

Note:

Preliminary Assessment Tool 1: Visual Magnitude is based on a 2D Assessment alone and does not take into account topography, vegetation or other screening factors which may reduce the potential for viewing turbines.

For detailed assessment of Non-participating Dwellings identified refer to ***Appendix E.***

N

0 2 4 6 8 10km

***Figure 10** Preliminary Assessment Tool 1: Visual Magnitude (Map Source: Six Maps)*

6.0 Preliminary Assessment Tools

6.3 Results of Preliminary Assessment Tool 1: Visual Magnitude

Application of the Preliminary Assessment Tools to the Valley of the Winds Wind Farm Project identified dwellings which require further assessment in accordance with the Bulletin. Non-participating dwellings identified within 3,350 metres and between 3,350 - 4,950 metres of the nearest proposed turbine are shown on ***Figure 10.***

Of the 112 Non-participating dwellings identified within 4,950 m of the nearest turbine:

- *42* non-participating dwellings have been identified within 3350 metres of a proposed wind turbine location (within the black line).

- *70* non-participating dwellings are located within 3350 - 4950 metres of a proposed wind turbine (within the blue line). This includes 25 dwellings in the settlement of Leadville (Dwellings 152 - 176).

Detailed assessments of representative dwellings from which the Project will be visible have been undertaken in ***Appendix E***.

6.4 Preliminary Assessment Tool 2: 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 11*** below provides examples of where a dwelling or key public viewpoint may have views to turbines in multiple 60° sectors.

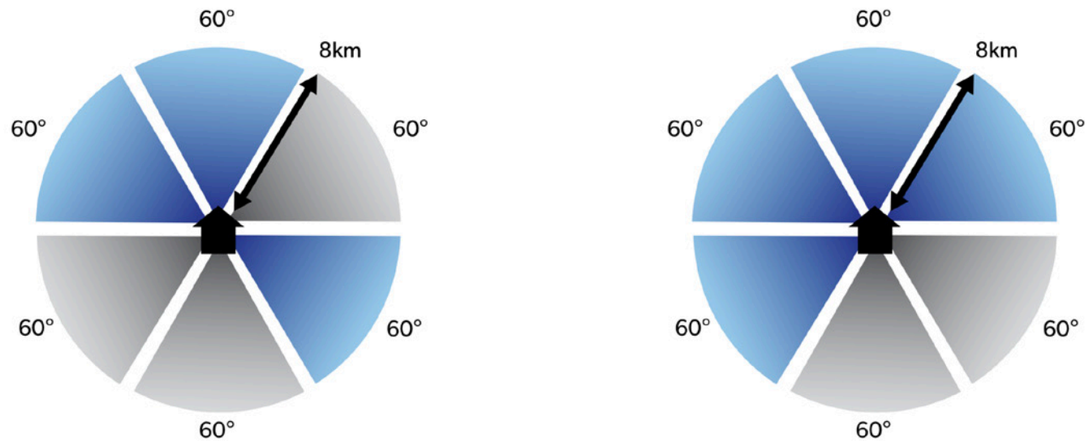
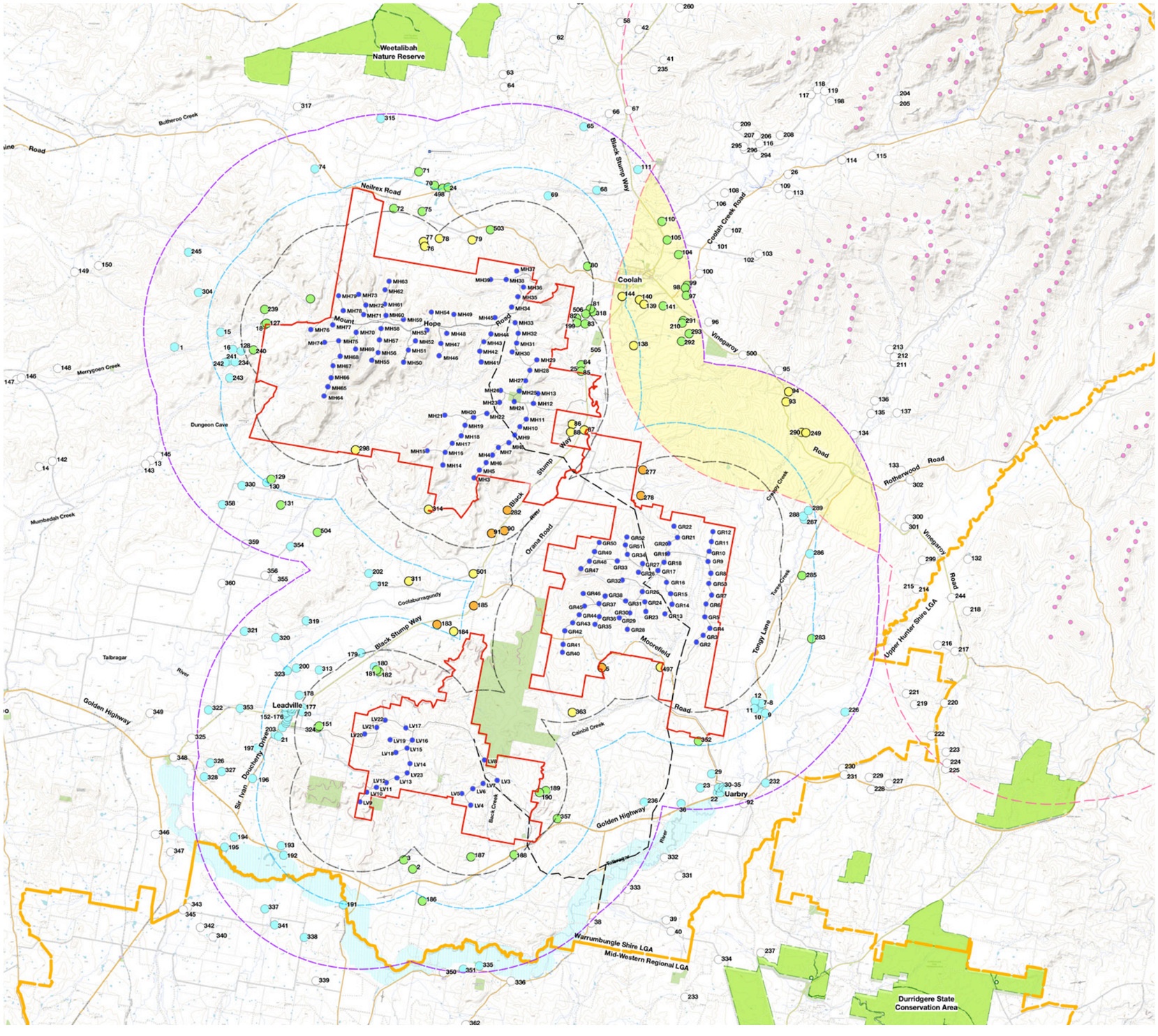


***Figure 11** Preliminary Assessment Tool: Multiple Wind Turbines (Source: Visual Assessment Bulletin)*

In accordance with the Bulletin *Where wind turbines are visible within the horizontal views of the dwelling or key public viewpoints in three or more 60° sectors, the proponents must identify the turbines, relative dwelling and key public viewpoint, along with the relative distance and submit these to the Department as part of the request for SEARs.* These turbines will become a focus for assessment in the EIS.

Figure 12 provides an overview of the number of 60° sectors visible from each of the dwellings identified within 8 kilometres.

6.0 Preliminary Assessment Tools



Multiple Wind Turbine Tool

Valley of the Winds Wind Farm

LEGEND:

- Project Boundary
- LGA Boundary
- Proposed HV transmission line
- MH77 Proposed 250 m Valley of the Winds (VoW) Turbine Location
- Liverpool Range Wind Farm (LRWF) Turbine Location (Modified Layout)
- 8000m from Valley of the Winds wind turbine
- 8000m from Liverpool Range Wind Farm wind turbine
- Major roads / highways
- Minor roads
- Dwellings within 8,000 m of LRWF and the VoW Project
  Refer to Cumulative Visual Impact Assessment: Section 11.0
- Dwelling in excess of 8 kilometres
- One 60° Sector (60°)
- Up to two (2) 60° Sectors (120°)
- Up to three (3) 60° Sectors (180°)
- Up to four (4) 60° Sectors (240°)

Note:

Preliminary Assessment Tool 2: Multiple Wind Turbine Tool is based on a 2D Assessment alone and does not take into account topography, vegetation or other screening factors which may reduce the potential for viewing multiple turbines.

For detailed assessment of Non-participating Dwellings identified refer to *Appendix E.*

***Figure 12** Preliminary Assessment Tool 2: Multiple Wind Turbine (Map Source: Six Maps)*

6.5 Results of Preliminary Assessment Tool 2: Multiple Wind Turbine Tool

When applied to the Project, the 2D Multiple Wind Turbine Tool (see ***Figure 12***) identified a total of 32 non-participating dwellings with turbines located in more than two (2) 60 degree sectors (see ***Appendix E***). All remaining non-participating dwellings had turbines within one (1) or two (2) 60 degree sectors which is deemed an acceptable level in accordance with the Bulletin.

The assessment is based on a 2D assessment and takes into account turbines associated with the Approved Liverpool Range Wind Farm (LRWF).

Dwellings with VoW turbines in up to three (3) 60 degree sectors:

- 14 non-participating dwellings have turbines associated with VoW Project alone located within up to three (3) 60 degree sectors.
- Of these 14 non-participating dwellings:
- 12 dwellings are within 4,950 m of the nearest turbine.
- The remaining two (2) non-participating dwellings are in excess of 4,950 m.

In accordance with the Bulletin, these non-participating dwellings have been assessed in further detailed in ***Appendix E)***.

Dwellings with turbines in up to four (4) 60 degree sectors:

- Eight (8) non-participating dwellings have turbines located within up to four (4) 60 degree sectors.
- Of these eight (8) non-participating dwellings, seven (7) dwellings are within 4,950 m of the nearest turbine.
- The remaining one (1) non-participating dwelling (Dwelling 183) is in excess of 4,950 m from the turbines associated with the Project.

An assessment of these dwelling has been discussed in ***Appendix E*** of this LVIA.

Dwellings within 8,000 m of LRWF and the Project

- Eight (8) non-participating dwellings have up to three (3) 60 degree sectors of turbines associated with the VoW Project and the turbines associated with LRWF (Dwellings 93, 94, 138, 139, 140, 144, 249 and 290).
- The township of Coolah is located within 8,000 m of both the VoW and LRWF Projects.

Note the turbines utilised for the assessment of the LRWF are associated with the Modification Layout which is not yet approved (accessed via *Tilt Renewables: Liverpool Range Wind Farm* Project website, accessed on 10th February 2022).

Further assessment of these eight (8) non-participating dwellings with turbines in multiple 60 degree sectors and the township of Coolah has been undertaken in ***Section 13.0*** Cumulative Visual Impact Assessment.

7.0 Zone of Visual Influence

7.1 Zone of Visual Influence

The Bulletin states *'the use of Geographic Information Systems (GIS) to facilitate the application of the tools will streamline the evaluation phase of the evaluation phase of a project during the pre-lodgement stage. This can also assist in refining the number of turbines and viewpoints that will ultimately need more detailed assessment.'*

Five (5) Zone of Visual Influence (ZVI) diagrams have been prepared for the Valley of the Winds Wind Farm to illustrate the theoretical visibility of the proposed project.

- ***Figure 13*** depicts the areas of land from which the proposed development may be visible and provides an indicative number of wind turbines based on the blade tip height of 250 metres.
- ***Figure 14*** illustrates the areas of land from which turbines associated with the Mount Hope Road Cluster of turbines (MH Cluster) would be visible at a hub height of 250 m.
- ***Figure 15*** illustrates the areas of land from which turbines associated with the Girragulang Road Cluster of turbines (GR Cluster) would be visible at a hub height of 250 m.
- ***Figure 16*** illustrates the areas of land from which turbines associated with the Leadville Cluster of turbines (LV Cluster) would be visible at a hub height of 250 m.

The 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 (Scottish Natural Heritage, 2017).

The ZVI has been determined through the use of digital topographic information and 3D modelling software *WindPro*. The ZVI has been assessed to approximately 10 km from the project. Although it is possible for the development to be visible from further than 10 km away, it is generally accepted that beyond 10 km visibility is diminished.

7.2 Summary of Zone of Visual Influence

7.2.1 Summary of ZVI

It is important to reiterate the ZVI is based on a worst case scenario assessment which does not consider vegetation or structures. Ground truthing was undertaken during field work to ascertain potential visibility taking into account structures and vegetation. The following provides an overview of the findings of the ZVI prepared for all three clusters at tip height (250m):

- The undulating topography that characterises the region limits opportunities to view the Project in its entirety.

- Highest visibility is identified along the ridgelines located within the development site for the three (3) clusters. The clusters, however, will not be visible in their entirety due to their elevated position and topographical changes.

- Views to the Project are limited from areas in excess of 10 kilometres due to topographical changes.

- Coolah and Leadville have larger population concentrations. Theoretically, Leadville will have the highest potential to view the Project impact due to its lower elevation and location relative to the Project. However, the ZVI does not consider the impact of vegetation and buildings which will play an important role in screening views.

7.0 Zone of Visibility

7.2.2 Mount Hope Cluster

The Mount Hope Cluster (MH Cluster) is the largest of the Project with up to 76 turbines. The cluster is located to the north of Black Stump Way and south of Neilrex Road, associated with Mount Hope Road.

The ZVI indicates all turbines associated with MH Cluster have the potential to be visible from the following locations:

Land to the north of the MH Cluster is associated with Neilrex Road. Roadside vegetation on the southern side of Neilrex Road is likely to contain views to the south for motorists travelling along the road. Land in this area is generally associated with agricultural land uses and a number of dwellings in this area have been assessed (refer to Appendix E). Views to LV Cluster and GR Cluster are unavailable from the land to the north of the MH Cluster.

Land to the east of the MH Cluster includes Coolah and land to the north east of Coolah surrounding Coolah Creek Road. The ZVI indicates views will be available to the MH Cluster from the township of Coolah, however these will be limited by intervening residences and associated vegetation. While views of the MH Cluster will be available from land surrounding Coolah Creek Road, these views will be in excess of 8 kms.

The ZVI indicates the MH Cluster is likely to be visible from parts of the Black Stump Way. These views would be on the vegetated ranges visible in excess of 8 kms from motorists travelling in a north east direction along the road from Leadville.

The ZVI indicated views of the MH Cluster are likely to be available from the towns of Leadville and Dunedoo, however it is important to note the ZVI does not take into account vegetation and built form. Further detailed assessment of the town of Leadville and Dunedoo indicates that vegetation, built form and distance limit the visibility of the MH Cluster from these towns.

7.2.3 Girragulang Cluster

The Girragulang Road (GR) Cluster is generally located to the north of Moorefield Road, to the south east of Black Stump Way. The GR Cluster is proposed to include up to 51 turbines.

The ZVI prepared for the GR Cluster indicates the visibility of turbines associated with the cluster are largely land associated with Black Stump Way, Tongy Lane, Uarbry and Coolah.

Views of the GR Cluster will be in excess of 10 kms from Coolah, and although they have the potential to be visible,views would be limited by intervening vegetation and built form.

Views to the GR Cluster will be available along Black Stump Way. Dwellings associated with Black Stump Way have been assessed in detail in Appendix E and it was identified that a number of these dwellings would have intervening vegetation that fragmented or screened views to the GR Cluster.

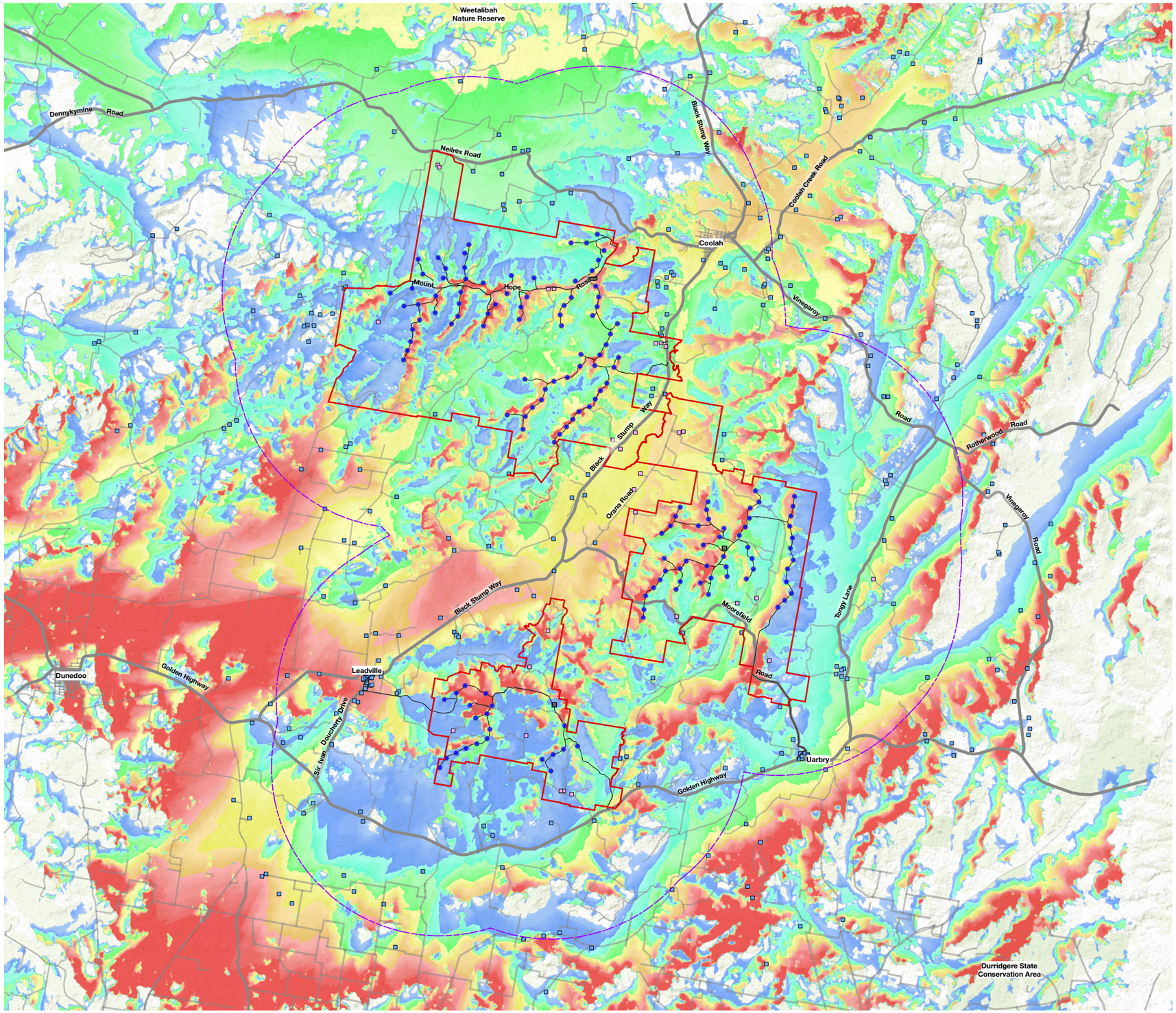
Views from the south and east of the GR Cluster are likely to be highest from the valley floor associated with Uarbry and Tongy Lane. Detailed assessment of dwellings associated with Tongy Lane and Uarbry provided in Appendix E indicate intervening vegetation will assist in reducing views to some turbines from these dwellings. Views to the MH and LV Clusters will be unavailable from Uarbry and Tongy Lane.

7.2.4 Leadville Cluster

The Leadville (LV) Cluster of turbines is located to the east of Leadville between Black Stump Way, the Golden Highway and Moorefield Road. Views to the LV Cluster are generally available to Leadville, Golden Highway and Black Stump Way.

Views to the turbines associated with the LV Cluster are likely to be available from Leadville township, however intervening vegetation and built form limits views.

Detailed dwelling assessments have been undertaken for dwellings within 4,950 m of the LV Cluster and have been included in Appendix E.



Zone of Visual Influence (ZVI) Blade Tip Height 250m

Valley of the Winds Wind Farm

LEGEND

- Project Boundary
- Proposed Turbine Location
- Participating Dwelling
- Non-Participating Dwelling
- 8000m from turbine
- Major roads / highways
- Minor roads

ZVI Legend:

Number of Visible Wind Turbines

- 0
- 1 - 25
- 26 - 50
- 51 - 75
- 76 - 100
- 101 - 125
- 126 - 148

Note:

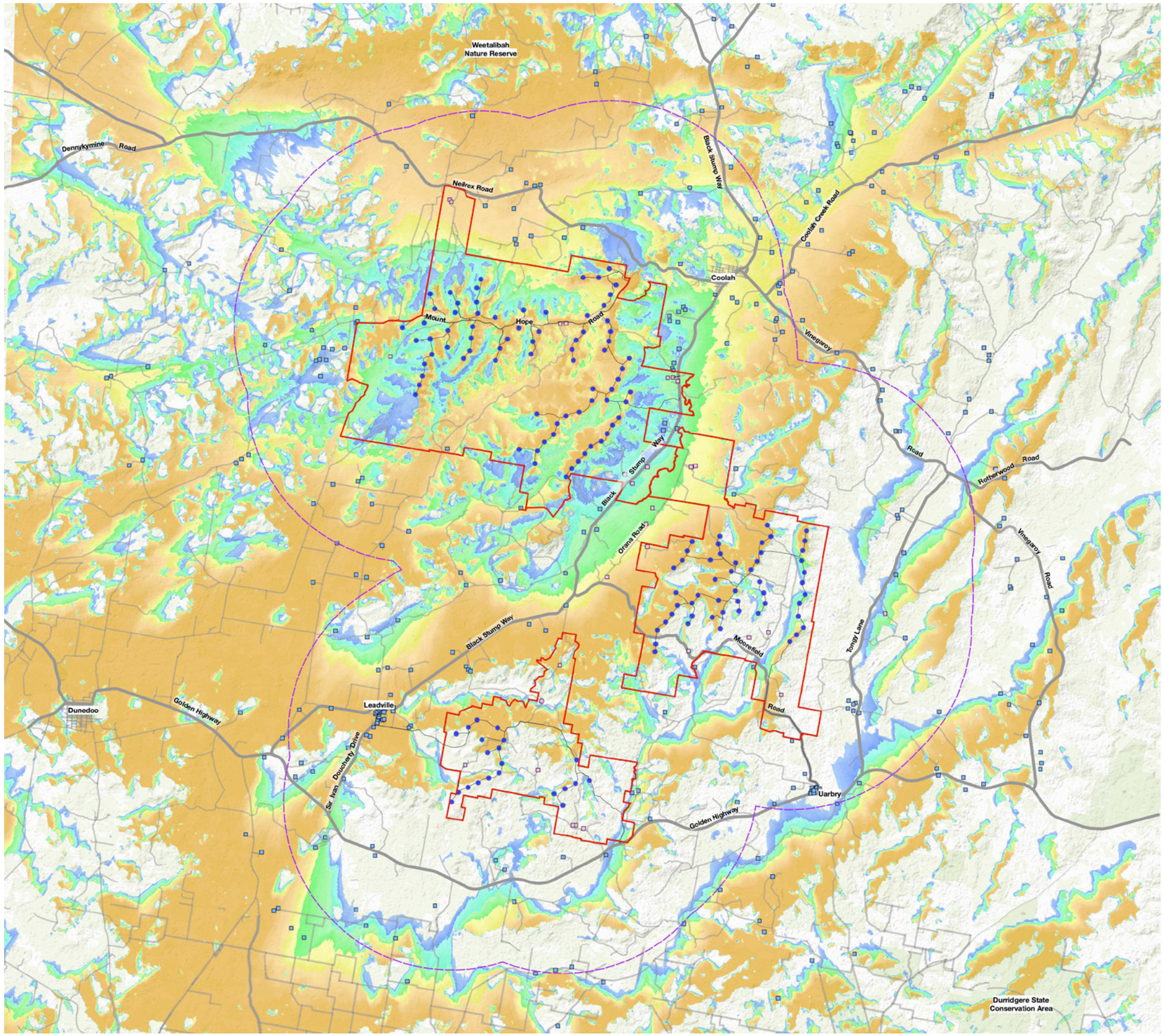
The ZVI is a preliminary assessment tool that represents a bare ground scenario - i.e. a landscape without screening, structures or vegetation. As accurate information on the height and coverage of vegetation and buildings is unavailable, it is important to note the ZVI is based solely on topographic information. Therefore this form of mapping should be acknowledged as representing the worst case scenario.

N

0 2 4 6 8 10km

***Figure 13** Zone of Visual Influence - Blade tip (250 metres) [Map Source: ESRI Topographic Maps]*

7.0 Zone of Visual Influence



Zone of Visual Influence (ZVI)

Mount Hope Road (MH) Cluster (250m)

LEGEND

- Project Boundary
- Proposed Turbine Location (Associated with Mount Hope Road Cluster)
- Proposed Turbine Location (Associated with GR / LV Clusters)
- Participating Dwelling
- Non-Participating Dwelling
- 8000m from turbine
- Major roads / highways
- Minor roads

ZVI Legend:

Number of Visible Wind Turbines
(Associated with the Mount Hope Road Cluster)

- 0
- 1 - 10
- 11 - 21
- 22 - 36
- 37 - 51
- 52 - 76

Note:

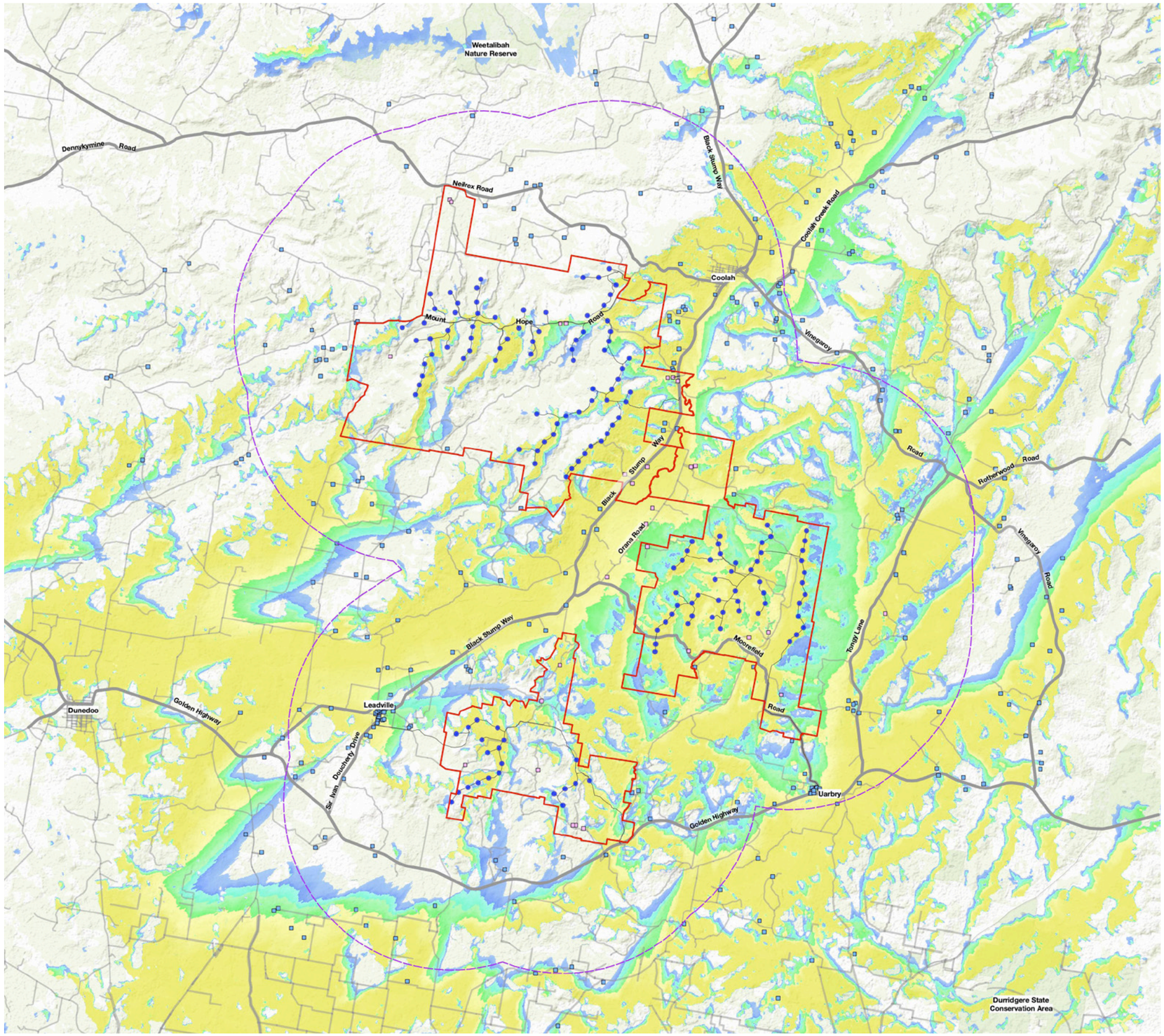
The ZVI is a preliminary assessment tool that represents a bare ground scenario - ie. a landscape without screening, structures or vegetation. As accurate information on the height and coverage of vegetation and buildings is unavailable, it is important to note the ZVI is based solely on topographic information. Therefore this form of mapping should be acknowledged as representing the worst case scenario.

N

0 2 4 6 8 10km

***Figure 14** Zone of Visual Influence - Mount Hope Road Cluster [Map Source: ESRI Topographic Maps]*

7.0 Zone of Visual Influence



Zone of Visual Influence (ZVI)

Girragulang Road (GR) Cluster (250m)

LEGEND

- Project Boundary
- Proposed Turbine Location (Associated with Girragulang Road Cluster)
- Proposed Turbine Location (Associated with MH / LV Clusters)
- Participating Dwelling
- Non-Participating Dwelling
- 8000m from turbine
- Major roads / highways
- Minor roads

ZVI Legend:

Number of Visible Wind Turbines
(Associated with the Girragulang Road Cluster)

- 0
- 1 - 10
- 11 - 21
- 22 - 36
- 37 - 51
- 52 - 76

Note:

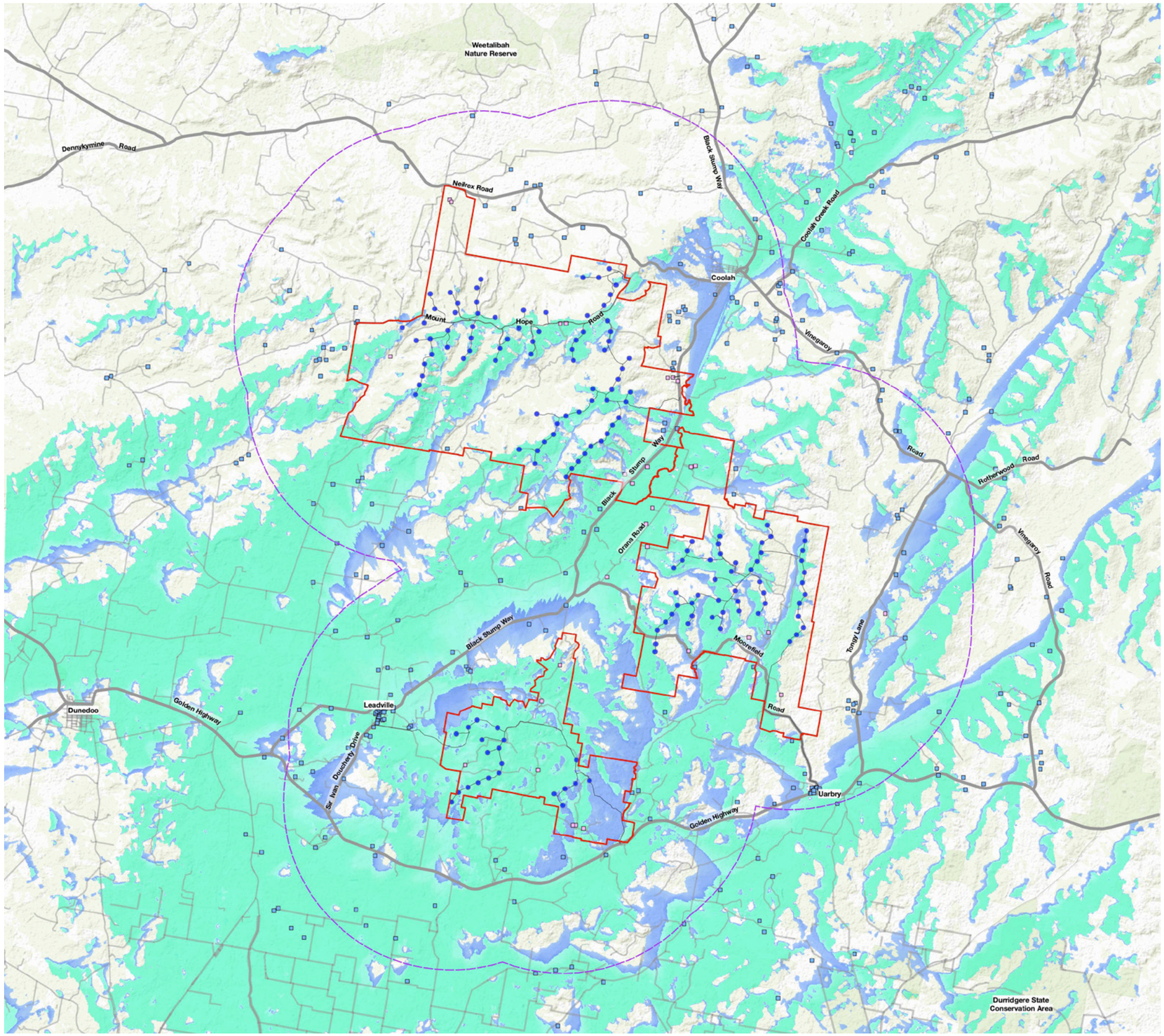
The ZVI is a preliminary assessment tool that represents a bare ground scenario - ie. a landscape without screening, structures or vegetation. As accurate information on the height and coverage of vegetation and buildings is unavailable, it is important to note the ZVI is based solely on topographic information. Therefore this form of mapping should be acknowledged as representing the worst case scenario.

N

0 2 4 6 8 10km

***Figure 15** Zone of Visual Influence - Girragulang Road Cluster [Map Source: ESRI Topographic Maps]*

7.0 Zone of Visual Influence



Zone of Visual Influence (ZVI)

Leadville (LV) Cluster (250m)

LEGEND

- Project Boundary
- Proposed Turbine Location (Associated with Girragulang Road Cluster)
- Proposed Turbine Location (Associated with MH / LV Clusters)
- Participating Dwelling
- Non-Participating Dwelling
- 8000m from turbine
- Major roads / highways
- Minor roads

ZVI Legend:

Number of Visible Wind Turbines
(Associated with the Leadville Cluster)

- 0
- 1 - 10
- 11 - 21
- 22 - 36
- 37 - 51
- 52 - 76

Note:

The ZVI is a preliminary assessment tool that represents a bare ground scenario - ie. a landscape without screening, structures or vegetation. 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.

N

0 2 4 6 8 10km

***Figure 16** Zone of Visual Influence - Leadville (LV) Cluster [Map Source: ESRI Topographic Maps]*

8.0 Public Viewpoint Analysis

8.1 Overview of Viewpoint Analysis

In accordance with the Bulletin 'all key public viewpoints and individual dwellings within the 'visual catchment' should be identified and assessed'.

A total of ***41*** viewpoints were taken from public locations during the field work process. Viewpoints have been carefully selected to be representative of the range of views within the Study Area. 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;

- viewpoints identified by the community in community consultation phase of scoping paper,
- 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.

The viewpoint locations assessed for the Project have included key viewpoints identified through the extensive community engagement throughout the development,.

The Bulletin states: *where relatively close clustering of houses belonging to different landowners or occupants occur, representative viewpoints may be selected and assessed in lieu of every single dwelling in the following types of areas:*

- rural residential clusters;
- rural villages; and
- urban residential and commercial areas.

Selected viewpoint assessment locations are shown on ***Figure 17***.

8.2 Viewpoint Analysis Methodology

Once the viewpoints had been selected, panoramic photographs are 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 are taken on a level tripod at a height of 150 cm (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. Parameters for the photography is provided in ***Table 7***.

The visual impact of the viewpoint was assessed both on site and through a desktop assessment utilising with the topographic and aerial information to ensure accuracy.

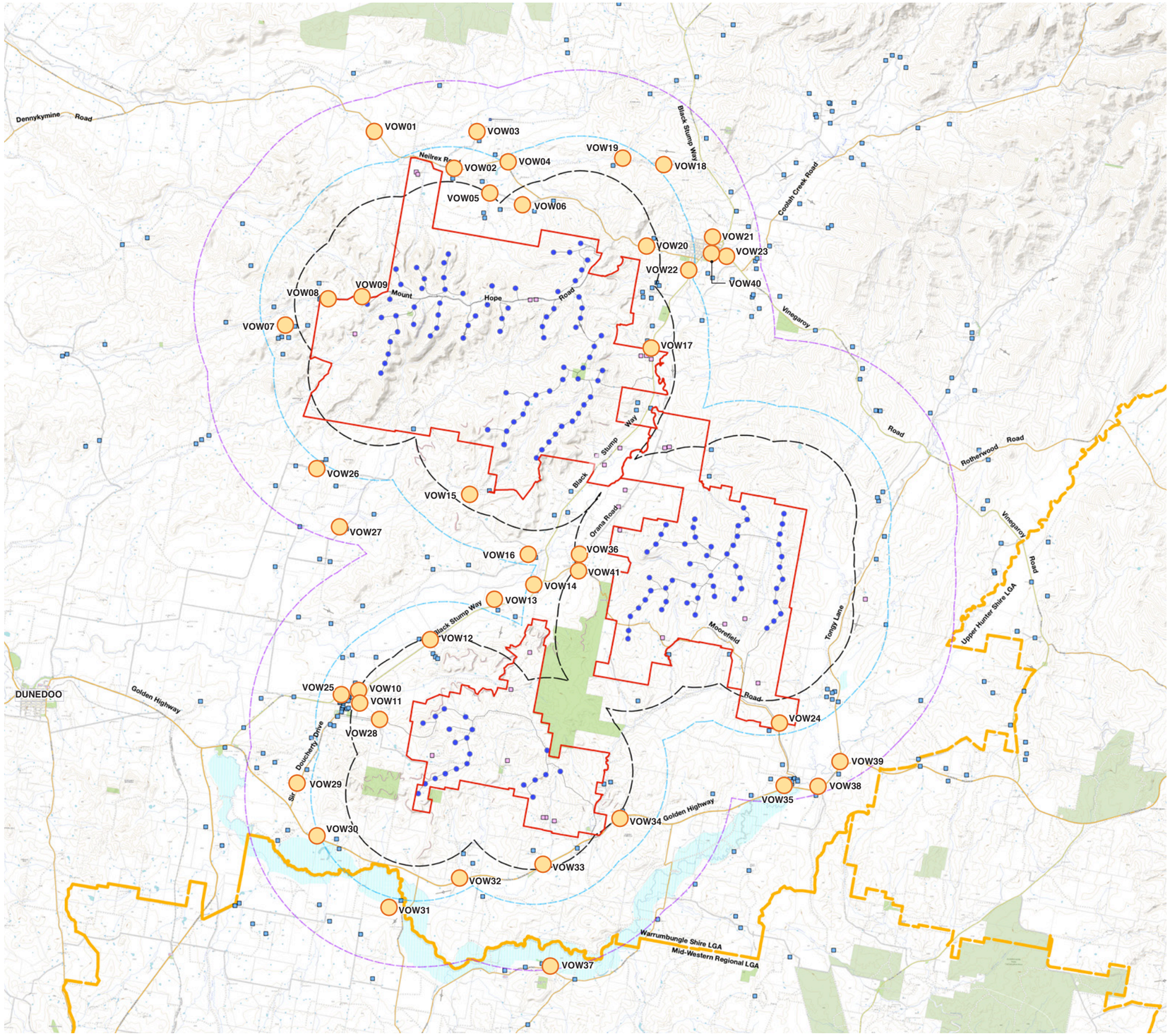
The locations of the viewpoints have been identified in ***Figure 14*** and the general viewing direction of each viewpoint is identified on the map on each viewpoint.

Viewpoint inventory prepared for the Project has been included as Appendix C.

Photography Specifications:	
Camera Make and Model:	**Canon EOS 5D Mark IV Full Frame Digital SLR**
Lens:	**EF50mm f/1.2L USM**
Focal Length:	**50mm f/0**
Aperture Setting:	**f/6.3 - 10**
Tripod Height:	**150cm**

Table 7. Photography Specifications

8.0 Public Viewpoint Analysis



Viewpoint Analysis Locations

Valley of the Winds Wind Farm

LEGEND:

- Project Boundary
- MH77 Proposed 250m Turbine Location
- Participating Dwelling
- Non-participating Dwelling
- LGA Boundary
- 8000m from turbine
- Major roads / highways
- Minor roads
- VOW01 Public Viewpoint Analysis Location

Note:

Refer to Appendix C for Viewpoint Analysis.

Detailed location plans are provided for each viewpoint.

N

0 2 4 6 8 10km

***Figure 17** Viewpoint Analysis Locations (Map Source: Six Maps)*

8.0 Public Viewpoint Analysis

8.3 Visual Influence Zone (VIZ)

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 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 ***Figure 18*** below and refer to tables in ***Section 17.0***). An evaluation using the corresponding visual performance objectives *(Table 2 of the Visual Assessment Bulletin)* has been included for each viewpoint.

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.

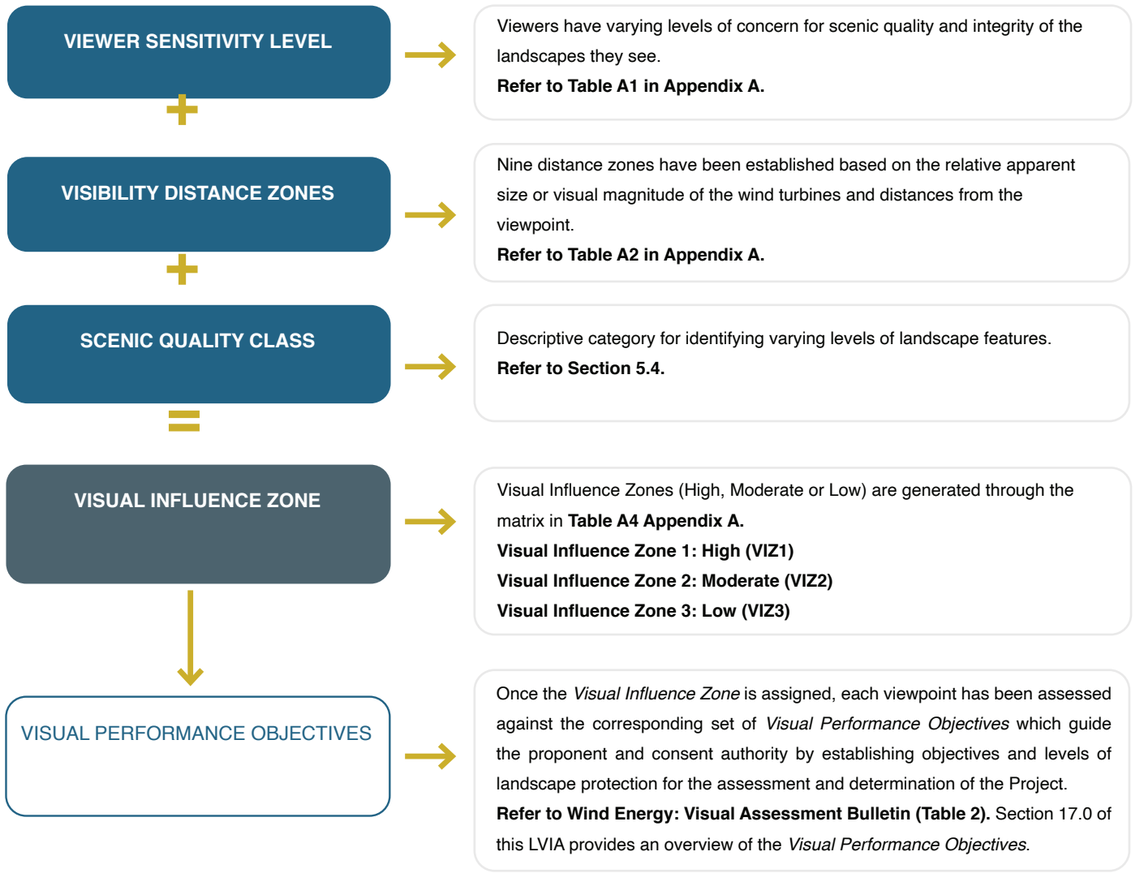


Figure 18 ***Methodology for determining Visual Influence Zone (VIZ)***

8.4 Summary of Viewpoint Analysis

The 41 public 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) based on their Viewer Sensitivity Level, Visibility Distance Zone and Scenic Quality Class combinations (refer to the methodology in ***Section 17.0***). In accordance with the objectives of the Bulletin, each viewpoint was assessed against the objectives for the VIZ. The following provides a brief overview of the viewpoint analysis which is located in ***Appendix C***. Photomontages have been undertaken from 7 public viewpoints to illustrate the potential visual impacts refer to ***Section 9.0*** and ***Appendix D***.

Visual Influence Zone 2 (VIZ2):

A total of 2 viewpoints were rated as Visual Influence Zone 2 (VIZ2) in accordance with the Bulletin. These viewpoints are located on Mount Hope Road, Coolah and Wardens Road, Leadville. The close proximity of these viewpoints and the Project led to this rating. However, all views from these viewpoints will be fleeting.

Visual Influence Zone 3 (VIZ3):

39 viewpoints were rated as VIZ3 in accordance with the methodology in the Bulletin.

9.0 Dwelling Assessments

9.1 Overview of Dwelling Assessment

9.1.1 Dwelling Assessment Requirements

The Bulletin states: *all key public viewpoints and individual dwellings within the 'visual catchment' should be identified and assessed.*

The Preliminary Assessment Tools (***Section 6.0***) defined the 'visual catchment' and identified non-participating residences within the Study Area which require further assessment. These include:

- 42 non-participating dwellings within 3,350m metres of the nearest turbine associated with the Project.
- 70 non-participating dwellings within 3,350 - 4,950 metres of the nearest turbine associated with the Project.
- Five (5) non-participating dwellings in excess of 4,950 metres have potential views to turbines associated with the Project and Liverpool Range Wind Farm in multiple 60° sectors.

9.1.2 Representative Dwellings

Due to the large scale of the Project and the number of dwellings within the visual catchment, representative dwellings have been assessed to provide an indication of the potential visual impacts from surrounding dwellings. This is consistent with the recommendations of the Bulletin which states: *where relatively close clustering of houses belonging to different landowners or occupants occur, representative viewpoints may be selected and assessed in lieu of every single dwelling.*

Where a cluster of dwelling is within close proximity to one another and sharing similar attributes a representative dwelling assessment has been provided to assess the cluster of dwellings. The dwelling selected for assessment is referred to as the 'representative dwelling' and the 'linked dwelling' refer to nearby dwellings that have similar impacts to the selected representative dwellings.

Figure 19, 20 and 21 and ***Tables 9 - 11*** provide an overview of the representative dwellings selected for assessment and 'linked dwellings'.

9.2 Study Method for Dwelling Assessment

The Bulletin states: *The black and blue lines are not determinative of acceptability. Instead, they provide a basis for the assessment to be undertaken. There may be reasons why the proposed turbine will not have the impact as identified by (the visual magnitude thresholds) and detailed justification can be provided for proposed turbines... for example ground truthing may identify that existing vegetation or topography will screen views to a proposed turbine'.*

Further detailed assessment identified a number of dwellings within the visual catchment are likely to have limited or no views to the Project due to topography and / or other screening factors such as vegetation.

Table 8 provides an overview of the study method for undertaking the dwelling assessment for each dwelling identified within the visual catchment.

9.0 Dwelling Assessments

Study Method	Process
Step 1: Application of Preliminary Assessment Tools	Preliminary Assessment Tools were applied in accordance with the Bulletin from each dwelling to assess the following two parameters: - Visual Magnitude (identify the number of turbines within blue and black lines) - Multiple 60º Sector Assessment (identify the number of 60º sectors based on a 2D assessment).
Step 2. 3D Assessment (based on topography alone)	Using 3D modelling, Moir LA identified turbines which will not be visible from the dwelling due to topography. As a result the extent of visibility is generally decreased when compared to the 2D assessment. The application of the Preliminary Assessment Tools are updated to account for 3D modelling.
Step 3. Aerial Imagery	Information on the extent of visibility extracted from the 3D model is then overlaid onto a recent aerial image of the dwelling and its surrounds. This provides a detailed assessment of the direction and extent of potentially visible turbines and identifies any intervening elements (such as structures, wind break planting or vegetation) which may reduce the potential visibility.
Step 4. Site Inspection	Where access was granted, Moir LA attended the property to undertake a site inspection to ground truth potential screening factors that were identified on aerial imagery. This included photographic assessment from the dwelling. During the site inspection Moir LA identified potential intervening elements including vegetation and structures.
Step 5: Photomontage / Wire Frame Diagrams	Where potential impacts were identified, photomontages or wire frame diagrams were prepared from dwellings to represent those with potential impacts or to best represent the appearance of the Project from clusters of dwellings.
Step 6. Evaluation of VIZ Objectives	In accordance with the Bulletin, the Visual Influence Zone was defined and the relevant objectives were evaluated for each dwelling based on the assessment.
Step 7. Visual Effect Rating	A visual effect rating is applied to each dwelling with regards to the parameters outlined in ***Section 14.3***.
Step 8. Consideration of mitigation methods	For non-associated dwellings where by the Project has the potential to cause visual impact, mitigation methods have been suggested. ***Refer to Section 16.***

Table 8. Dwelling Assessment Process

9.3 Summary of Dwelling Assessment

9.3.1 Dwellings within 3,350 metres of the nearest turbine

A total of 42 non-participating dwellings were identified within 3,350 metres of a proposed turbine. Representative dwelling assessment have been undertaken for 31 non-participating dwellings within 3,350 of the nearest turbine.

Of the 42 non-participating dwellings within 3,350 m the assessment found:

- Six (6) were rated as nil / negligible visual impact rating
- 19 were rated as having a low visual impact rating
- 14 were assessed as having a moderate visual impact rating
- Three (3) were assessed as having a high visual impact rating.

An overview of the visual assessment for each of the representative dwellings and detailed assessments have been included in ***Appendix E***.

9.3.2 Dwellings within 3,350 - 4,950 metres of the nearest turbine

A total of 70 non-participating dwellings were identified within 3,350 - 4,950 metres of a proposed turbine. This includes 27 non-participating dwellings associated with the township of Leadville.

Representative dwelling assessment have been undertaken for 30 non-participating dwellings within the 3,350 - 4,950 m of the nearest turbine.

Of the 70 non-participating dwellings between 3,350 - 4,950 m the assessment found:

- 18 were assessed as having nil / negligible visual impact rating,
- 13 were assessed as having a low visual impact rating (this includes 27 dwellings located within the Leadville township)
- 15 were assessed as having a moderate visual impact rating

Numbers above do not include 24 non-participating linked dwellings associated with Leadville. An assessment has been undertaken from representative non-participating Dwelling 154, which was rated as having a moderate visual impact. It is worth noting the representative dwelling selected was based on a worst case scenario on the eastern side of the township. Existing built form and vegetation within the township is likely to screen views from most dwellings within the township, resulting in a generally

low visual impact from dwellings associated with the Leadville township (refer to Viewpoint 25).

An overview of the visual assessment for each of these representative dwellings has been provided in ***Appendix E***.

9.3.3 Dwellings in excess of 4,950 metres of the nearest turbine

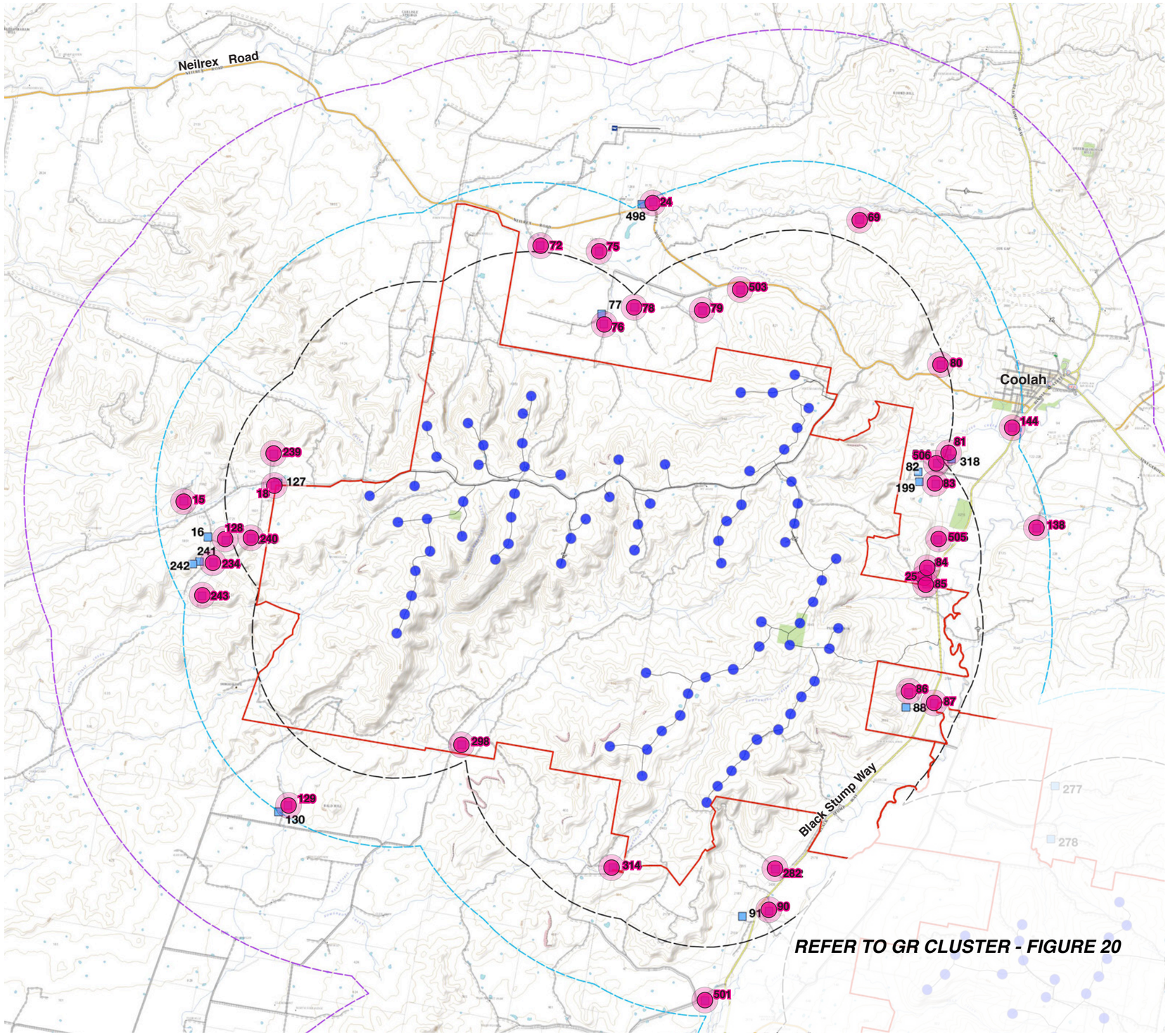
Nine (9) non-participating dwellings were identified in excess of 4,950m with the potential to view turbines in three (3) or more 60 degree sectors. Of these, six (6) dwellings have views associated with VOW & LRWF. Assessment of these dwellings is discussed in ***Section 13.0***, the remaining three (3) dwellings have been assessed in ***Appendix E***.

The Bulletin states: *where relatively close clustering of houses belonging to different landowners or occupants occur, representative viewpoints may be selected and assessed in lieu of every single dwelling in the following types of areas:*

- *rural residential clusters;*
- *rural villages; and*
- *urban residential and commercial areas.*

In addition to the detailed assessment of dwellings identified within the visual catchment, Moir LA undertook an extensive Viewpoint Analysis which provides representative visual assessments from dwellings in excess of 4,950 metres of the Project (refer to ***Section 8.0***).

9.0 Dwelling Assessments



Dwelling Assessment Locations (MH Cluster)

Valley of the Winds Wind Farm

LEGEND:

- Project Boundary
- Proposed 250m Turbine Location
- 25 Assessed Non-participating Dwellings
- 127 Linked Non-participating Dwellings
- 3350m from turbine
- 4950m from turbine
- 8000m from turbine
- Roads

Note:

Refer to Appendix E for Dwelling Assessments.

Detailed location plans are provided for each dwelling location.

N

0 2 4 6 8km

***Figure 19** Dwelling Assessment Locations - MH Cluster (Map Source: Six Maps)*

9.0 Dwelling Assessments

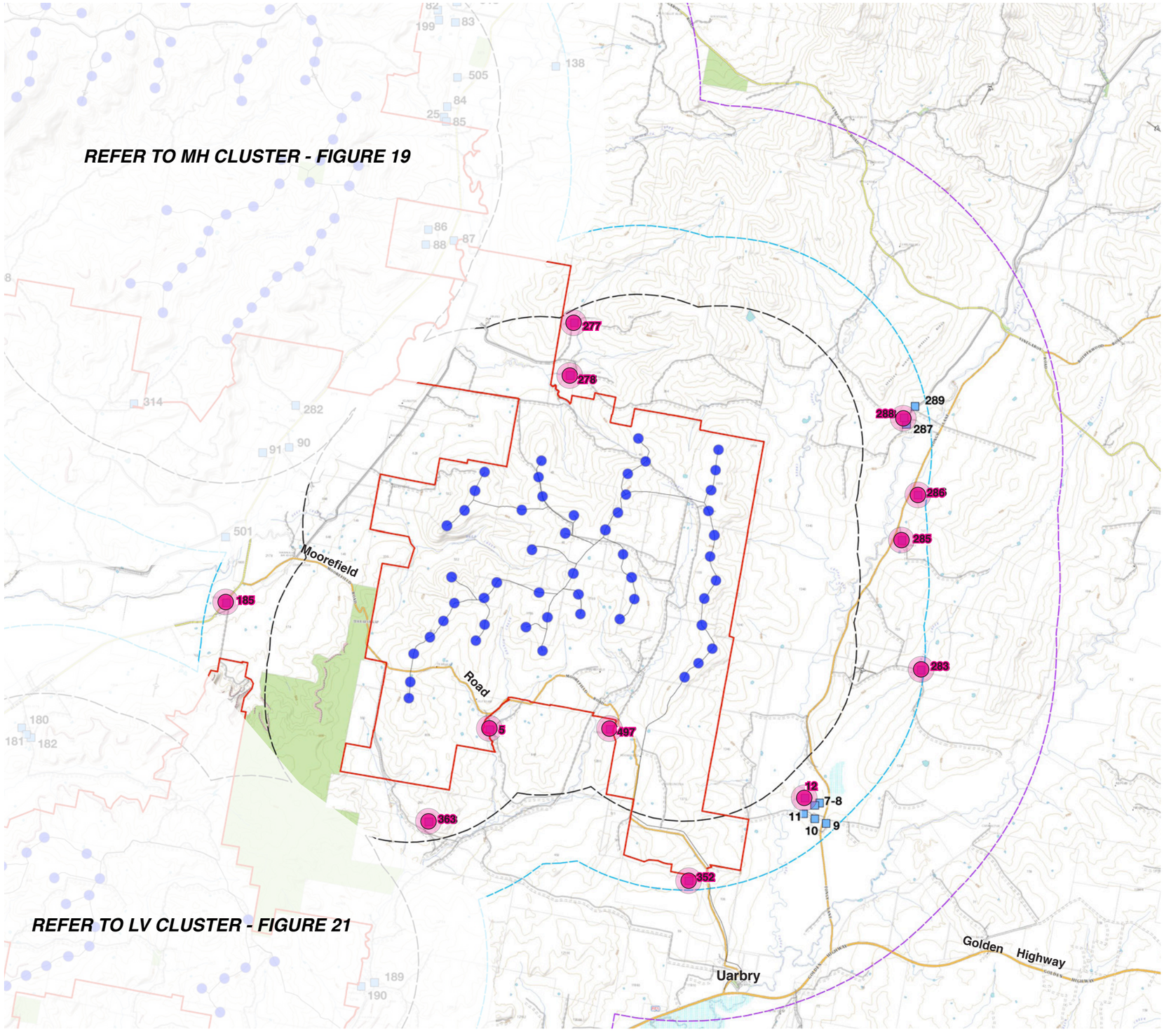
Overview of Non-participating MH Cluster Dwellings		
Dwellings within 3,350m (black line)		
Representative Dwelling	**Linked Dwellings**	**MLA Comments**
Dwelling 18	**Dwelling 127**	Refer Appendix E.1.
Dwelling 25		Refer Appendix E.2.
Dwelling 76	**Dwelling 77**	Refer Appendix E.3.
Dwelling 78		Refer Appendix E.4.
Dwelling 79		Refer Appendix E.5.
Dwelling 80		Refer Appendix E.6.
Dwelling 83	**Dwellings 82 & 199**	Refer Appendix E.7.
Dwelling 84		Refer Appendix E.8.
Dwelling 85		Refer Appendix E.9.
Dwelling 86	**Dwelling 88**	Refer Appendix E.10.
Dwelling 87		Refer Appendix E.11.
Dwelling 90	**Dwelling 91**	Refer Appendix E.12.
Dwelling 239		Refer Appendix E.13.
Dwelling 240		Refer Appendix E.14.
Dwelling 282		Refer Appendix E.15.
Dwelling 298		Refer Appendix E.16.
Dwelling 314		Refer Appendix E.17.
Dwelling 503		Refer Appendix E.18.
Dwelling 505		Refer Appendix E.19.
Dwelling 506		Refer Appendix E.20.

Table 9. Overview of Non-participating MH Cluster Dwellings

Overview of Non-participating MH Cluster Dwellings		
Dwellings between 3,350m - 4,950m (black and blue lines)		
Representative Dwelling	**Linked Dwellings**	**MLA Comments**
Dwelling 15		Refer Appendix E.32.
Dwelling 24	**Dwelling 498**	Refer Appendix E.33.
Dwelling 69		Refer Appendix E.34.
Dwelling 72		Refer Appendix E.35.
Dwelling 75		Refer Appendix E.36.
Dwelling 81	**Dwelling 318**	Refer Appendix E.37.
Dwelling 128	**Dwelling 16**	Refer Appendix E.38.
Dwelling 129	**Dwelling 130**	Refer Appendix E.39.
Dwelling 138		Refer Appendix E.40.
Dwelling 144		Refer Appendix E.41.
Dwelling 234	**Dwellings 241 & 242**	Refer Appendix E.42.
Dwelling 243		Refer Appendix E.43.
Dwelling 501		Refer Appendix E.44.

Table 9 (continued). Overview of Non-participating MH Cluster Dwellings

9.0 Dwelling Assessments



Dwelling Assessment Locations (GR Cluster)

Valley of the Winds Wind Farm

LEGEND:

- Project Boundary
- Proposed 250m Turbine Location
- 277 Assessed Non-participating Dwellings
- 288 Linked Non-participating Dwellings
- 3350m from turbine
- 4950m from turbine
- 8000m from turbine
- Roads

Note:

Refer to Appendix E for Dwelling Assessments.

Detailed location plans are provided for each dwelling location.

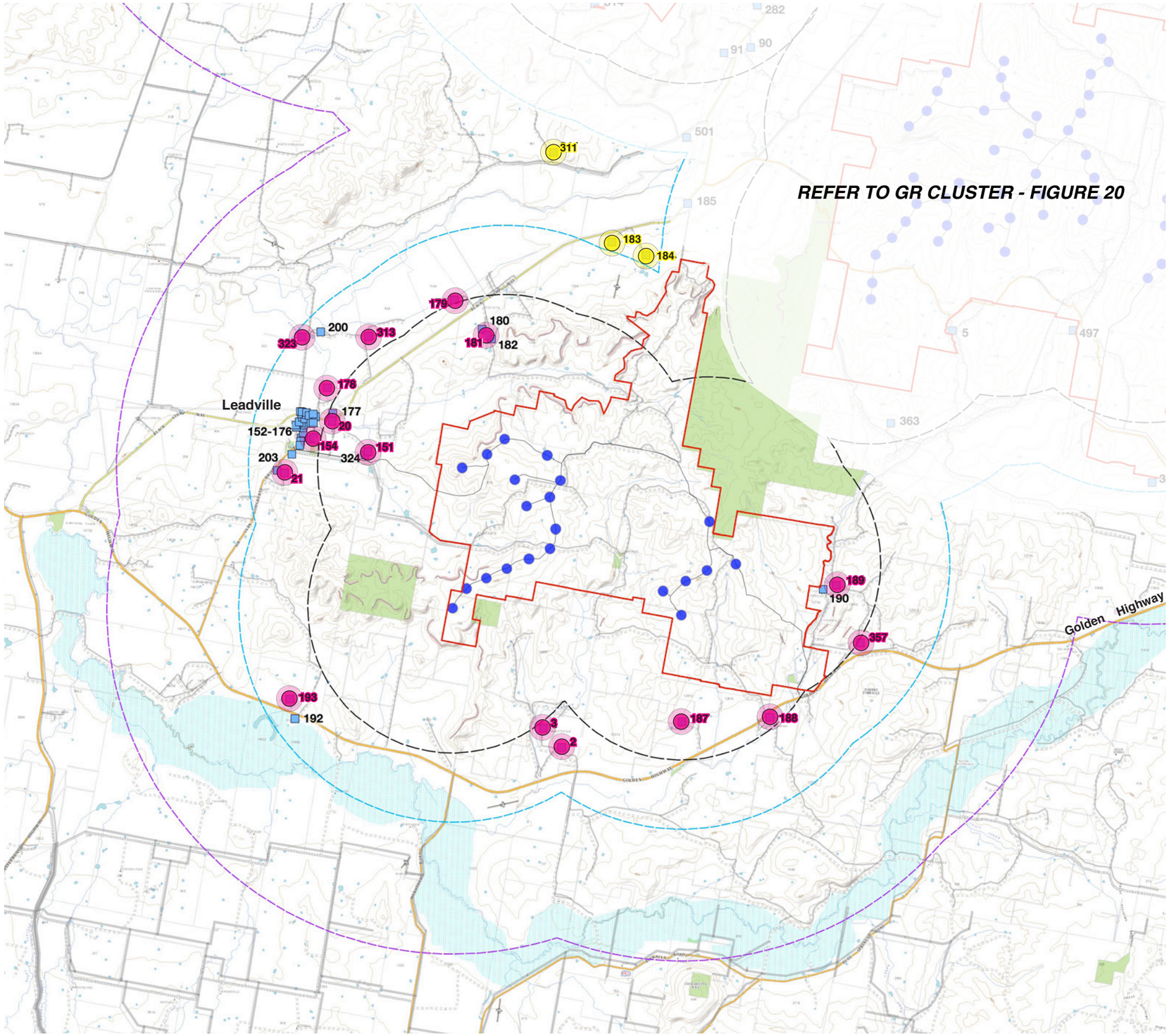
***Figure 20** Dwelling Assessment Locations - GR Cluster (Map Source: Six Maps)*

9.0 Dwelling Assessments

Overview of Non-participating GR Cluster Dwellings		
Dwellings within 3,350m (black line)		
Representative Dwelling	**Linked Dwellings**	**MLA Comments**
Dwelling 5		Refer Appendix E.21.
Dwelling 277		Refer Appendix E.22.
Dwelling 278		Refer Appendix E.23.
Dwelling 363		Refer Appendix E.24.
Dwelling 497		Refer Appendix E.25.

Overview of Non-participating GR Cluster Dwellings		
Dwellings between 3,350m - 4,950m (black and blue lines)		
Representative Dwelling	**Linked Dwellings**	**MLA Comments**
Dwelling 12	**Dwellings 7-11**	Refer Appendix E.45.
Dwelling 185		Refer Appendix E.46.
Dwelling 283		Refer Appendix E.47.
Dwelling 285		Refer Appendix E.48.
Dwelling 286		Refer Appendix E.49.
Dwelling 288	**Dwellings 287 & 289**	Refer Appendix E.50.
Dwelling 352		Refer Appendix E.51.

Table 10. Overview of Non-participating GR Cluster Dwellings



Dwelling Assessment Locations (LV Cluster)

Valley of the Winds Wind Farm

LEGEND:

- Project Boundary
- Proposed 250m Turbine Location
- 189 Assessed Non-participating Dwellings within 4,950m
- 311 Assessed Non-participating Dwellings outside of 4,950m
- 200 Linked Non-participating Dwellings
- 3350m from turbine
- 4950m from turbine
- 8000m from turbine
- Roads

Note:

Refer to Appendix E for Dwelling Assessments.

Detailed location plans are provided for each dwelling location.

N

0 2 4 6 8km

***Figure 21** Dwelling Assessment Locations - LV Cluster & Dwellings With Multiple Visible Sectors (Map Source: Six Maps)*

9.0 Dwelling Assessments

Overview of Non-participating LV Cluster Dwellings		
Dwellings within 3,350m (black line)		
Representative Dwelling	**Linked Dwellings**	**MLA Comments**
Dwelling 20	**Dwelling 177**	Refer Appendix E.26.
Dwelling 151	**Dwelling 324**	Refer Appendix E.27.
Dwelling 181	**Dwelling 180 & 182**	Refer Appendix E.28.
Dwelling 187		Refer Appendix E.29.
Dwelling 188		Refer Appendix E.30.
Dwelling 189	**Dwelling 190**	Refer Appendix E.31.
Overview of Non-participating LV Cluster Dwellings		
Dwellings between 3,350m - 4,950m (black and blue lines)		
Representative Dwelling	**Linked Dwellings**	**MLA Comments**
Dwelling 2		Refer Appendix E.52.
Dwelling 3		Refer Appendix E.53.
Dwelling 21	**Dwelling 203**	Refer Appendix E.54.
Dwelling 154	**Dwellings 152, 153 & 155-176**	Refer Appendix E.55.
Dwelling 178		Refer Appendix E.56.
Dwelling 179		Refer Appendix E.57.
Dwelling 193	**Dwelling 192**	Refer Appendix E.58.
Dwelling 313		Refer Appendix E.59.
Dwelling 323	**Dwelling 200**	Refer Appendix E.60.
Dwelling 357		Refer Appendix E.61.
Overview of Non-participating LV Cluster Dwellings with Multiple Visible Sectors		
Dwellings outside 4,950m (outside blue line)		
Representative Dwelling	**Linked Dwellings**	**MLA Comments**
Dwelling 183		Refer Appendix E.62.
Dwelling 184		Refer Appendix E.63.
Dwelling 311		Refer Appendix E.64.

Table 11. Overview of Non-participating GR Cluster Dwellings

10.0 Photomontages & Wire Frame Diagrams

10.1 Overview of Photomontages and Wire Frame Diagrams

10.1.1 Photomontages

The Bulletin states: *Photomontages shall be prepared in accordance with the Scottish Natural Heritage Visual Representation of Wind Farms, Version 2.1 December 2014 guidelines, noting they are generally consistent with the Land and Environment Court's Photomontage Policy. The visual assessment needs to include a concise description of the complete methodology used to create any photomontages presented in the visual assessment.*

A photomontage combines a photograph of an existing view with a computer-rendered image of a proposed development. Photomontages are used to illustrate the likely view of a proposed development as it would be seen in a photograph (not as it would appear to the human eye in the field).

Although photomontages are based on a photograph of the existing landscape, it is important to stress that they are not a substitute to visiting a viewpoint in the field. They are only one tool to aid assessment. They provide a two-dimensional image that can be compared with an actual view of the landscape to provide information, such as the scale and potential appearance of a proposed development.

Photomontages prepared for the Project have been included as Appendix D.

10.1.2 Wire Frame Diagrams

A wire frame is a computer generated image based on a digital terrain model, that indicate the 3D 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 (Scottish Natural Heritage, 2017). Wire frame images can be seen as a worst case scenario as they do not take into account factors such as vegetation, building structures.

Wire frame diagrams have been utilised in this LVIA to assist in the assessment of the Project from inaccessible locations. In instances where access to a private property was not granted, wire frame diagrams have been utilised as an assessment tool to provide a worst case scenario view of the proposal.

Wire frame images have also been utilised as a substitute for photomontages in areas where dense vegetation limits the capacity to align photographs accurately.

10.2 Photomontage Limitations

Visualisations in themselves can never provide the full picture in terms of potential impacts; they only inform the assessment process by which judgements are made. Visualisations of wind farms have a number of limitations which stakeholders should be aware of when using them to form a judgement on a wind farm proposal.

These include:

- A visualisation can never show exactly what the wind farm will look like in reality due to factors such as: different lighting, weather and seasonal conditions which vary through time and the resolution of the image;
- The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate;
- A static image cannot convey turbine movement, or flicker or reflection from the sun on the turbine blades as they move.

Source: Scottish Natural Heritage Visual Representation of Wind Farms, Version 2.2 February 2017.

10.3 Photomontage Selection Process

Indicative viewpoints have been selected for the preparation of photomontages from public locations and private dwelling locations to best illustrate the potential appearance of the proposed wind farm from varying distances and locations with differing views in public locations (refer to ***Figure 23***).

Public Photomontage Locations:

A total of ***seven (7) public viewpoint locations*** selected for the preparation of visual photomontages are based on feedback received from the community. Exact photomontage locations were selected on site to represent a worst case scenario for the viewpoint location. Localised screening factors such as vegetation were avoided (where possible) to ensure maximum exposure to the Project.

Private Photomontage Locations:

19 photomontages and 13 wire frame diagrams have been prepared from private properties. The locations selected were based on those that granted access.

10.0 Photomontages & Wire Frame Diagrams

10.4 Photomontage Development Methodology

The process for generating the photomontages 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 22***.

The photomontages are based on a worst case scenario of a maximum turbine height dimension of 250 m with a hub height of 160 m and rotor diameter of 180 m, without the inclusion of the proposed mitigation methods.

Moir Landscape Architecture have prepared the photomontages using the most current available version of *Wind Pro* software using the following process:

Step 1: Develop 3D Model

Detailed 3D model of the Site is developed in *Wind Pro*. The wind turbines and associated infrastructure (substations, transmission lines, wind masts etc.) are modelled and sited in the 3D model to scale.

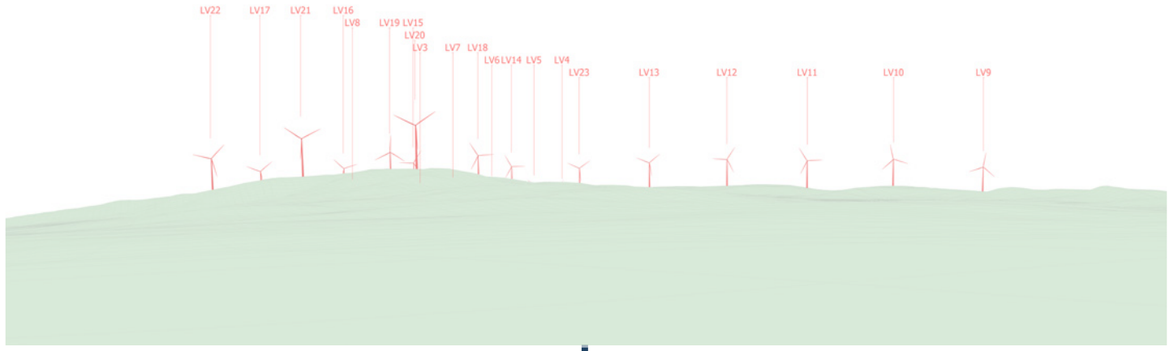
Step 2: Align Photograph and Model

The digital panorama is imported into Wind Pro and EXIF properties of the file are inserted automatically defining all relevant visualization information as e.g. type of camera lens used, field of view for panoramas, the position and direction. Topography, control points, obstacle objects, existing wind masts can be used as reference to calibrate the camera model precisely.

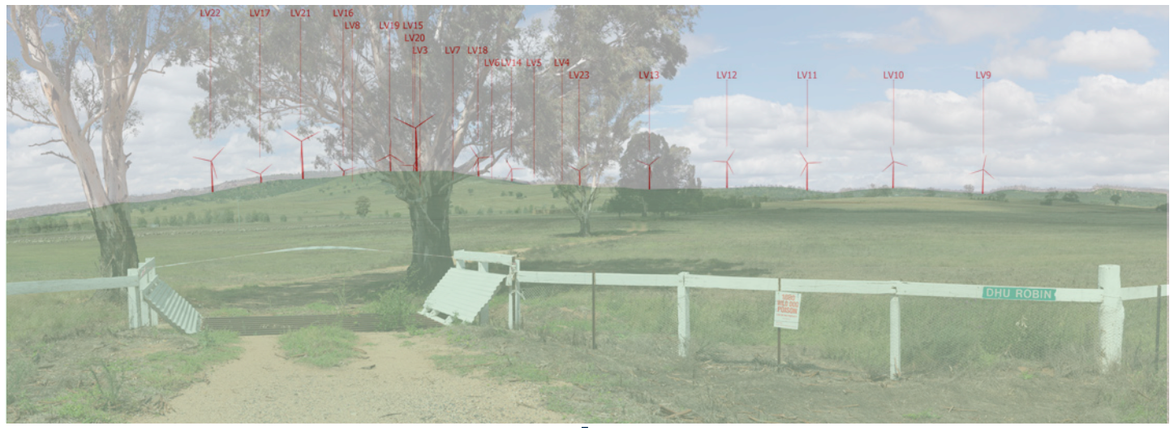
Step 3: Render Photomontage

The software calculates the position of the sun based on the time and date of photograph and renders the wind turbines in accordance with the specific weather conditions and position of the sun. Once rendered, detailed removal of intervening elements (such as vegetation) is undertaken to provide an accurate representation of the Project.

Step 1: Develop 3D Model (Wire Frame Diagram)



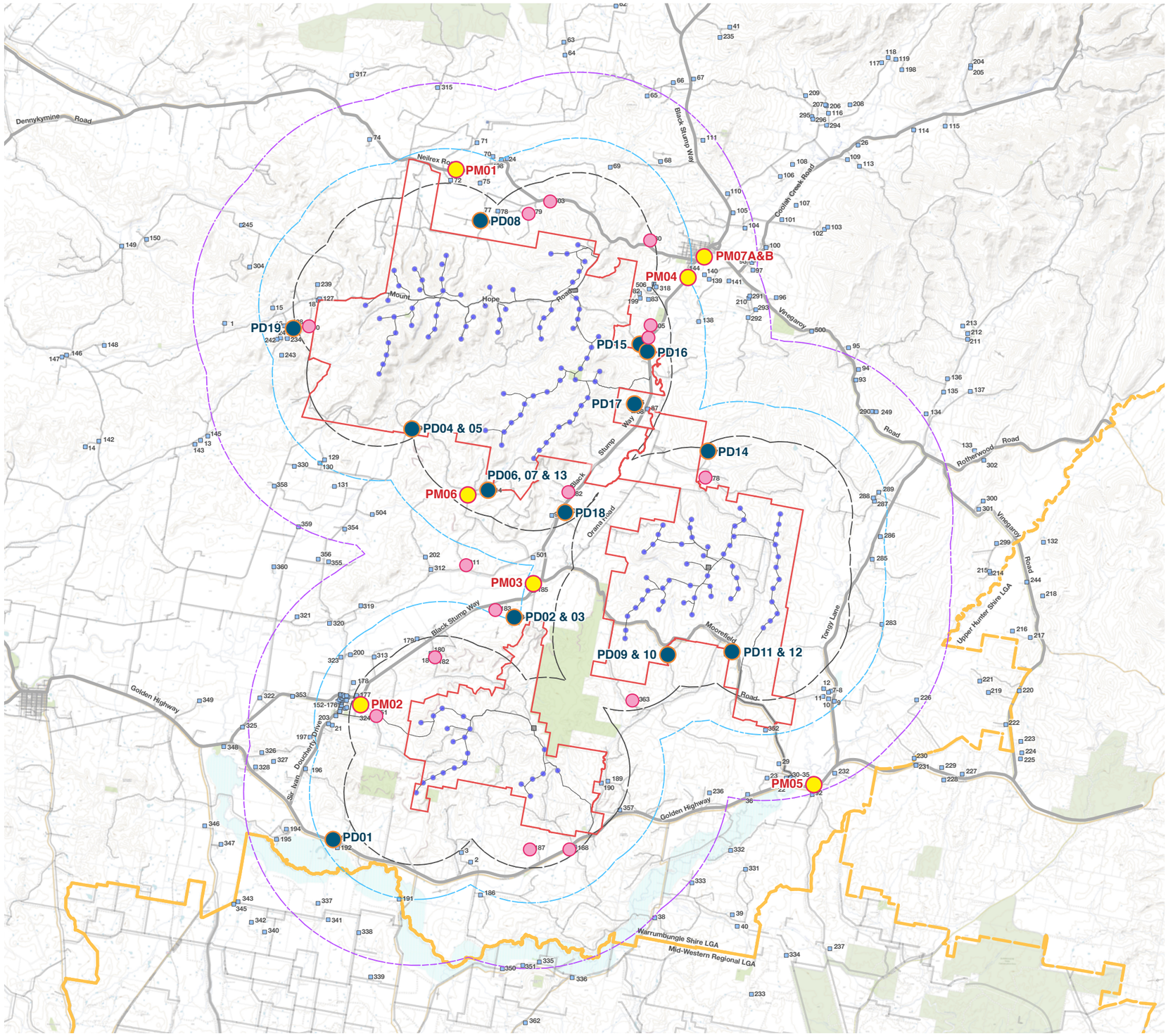
Step 2: Align photograph and model



Step 3: Render Photomontage

***Figure 22* Photomontage Development Process**

10.0 Photomontages & Wire Frame Diagrams



Photomontage and Wire Fram Diagram Locations

Valley of the Winds Wind Farm

LEGEND:

- Project Boundary
- MH77 Proposed 250m Turbine Location
- Participating Dwelling
- Non-participating Dwelling
- LGA Boundary
- 3350m from turbine
- 4950m from turbine
- 8000m from turbine
- Major roads / highways
- Minor roads
- PM01 Public Photomontage Locations
- PM01 Private Dwelling Photomontage Locations
- Wire Frame Diagram Locations

Note:

Refer to Appendix D for Photomontages.

Detailed location plans are provided for each photomontage location.

N

0 2 4 6 8 10km

***Figure 23** Photomontage Locations (Map Source: Six Maps)*

11.0 Shadow Flicker & Blade Glint Assessment

11.1 Overview of 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 (Draft National Wind Farm Development Guidelines, 2016).

The Bulletin states: *The shadow flicker caused by certain sun angles in relation to the rotation of wind turbine blades on dwellings will be limited to 30 hours per year, and may require mitigation measures such as amended siting and design of turbines to minimise the amount of shadow flicker.*

11.2 Shadow Flicker Assessment Methodology

As there is no methodology for the assessment of shadow flicker in the Bulletin, Moir LA have referred to the Draft National Wind Energy Guidelines (2010) to define the parameters for the assessment.

Modelling of the shadow flicker was conducted using specialist industry software (Wind Pro), assessing the largest turbine (based on a 250 m maximum tip height) proposed for the project to represent the worst case impact scenario. Refer to **Figure 24**.

The parameters used for the Shadow Flicker Assessment are as follows:

Model Parameter	Setting Used:
Zone of Visual Influence of Shadows	265 x Maximum blade chord
Minimum angle of sun	3 degrees
Shape of the sun	Disk
Time and duration of modelling	One full year
Orientation of the rotor	The rotor plane is always perpendicular to the line from the WTG to the sun
Time step	1 minute
Effects of topography	Included
Receptor Height	1.7 meters
Grid size	1 meter

Table 12** **Shadow Flicker Assessment Parameters

It is important to note the shadow flicker modelling undertaken for the Project 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).

Image 18. Example of shadow intensity variation with distance.

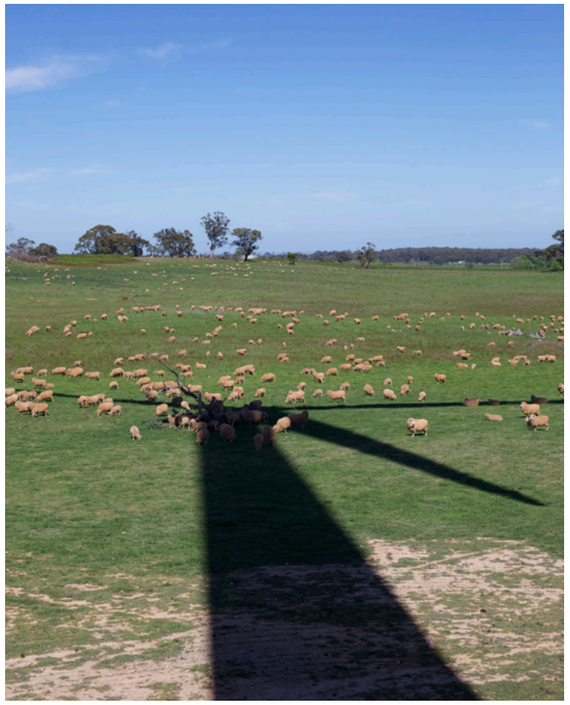
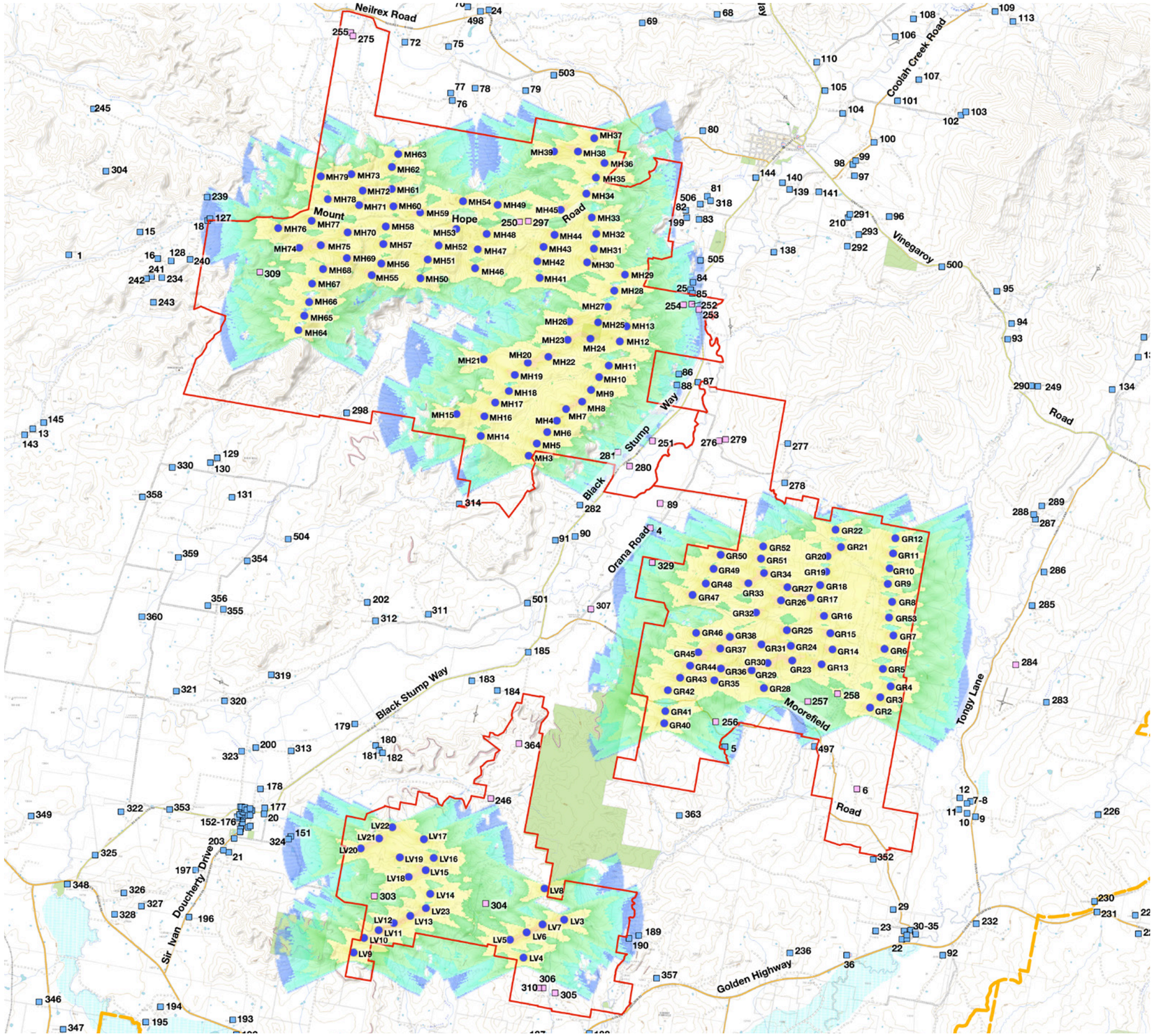


Image 19. Example of shadow flicker from base of turbine.

11.0 Shadow Flicker & Blade Glint Assessment



Shadow Flicker Assessment
Valley of the Winds Wind Farm

LEGEND

- Project Boundary
- Proposed Turbine Location
- Participating Dwelling
- Non-Participating Dwelling
- Major roads / highways
- Minor roads

Number of Hours of potential Shadow Flicker per year:

- 0
- 0.1 - <10 Hours
- 10 - < 30 Hours
- 30 - < 100 Hours
- 100 - < 500 Hours
- 500 - < 1,000 Hours
- 1,000 - 2,000 Hours

Assumptions for shadow calculations :

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values.

The calculated times are “worst case” given by the following assumptions:

- The sun is shining all the day, from sunrise to sunset.
- The rotor plane is always perpendicular to the line from the WTG to the sun.
- The WTG is always operating.

N

0 2 4 6 8 10km

Figure 24 ***Shadow Flicker Assessment Diagram [Map Source: Six Maps]***

11.0 Shadow Flicker & Blade Glint Assessment

11.3 Results of Shadow Flicker Assessment

A total of fourteen (14) non-participating dwellings were identified with potential shadow flicker hours. Refer to ***Table 13***.

The Bulletin states: *the shadow flicker caused by certain sun angles in relation to the rotation of wind turbine blades on dwellings will be limited to 30 hours per year, and may require mitigation methods such as amend siting and design of turbines to minimise the amount of shadow flicker.*

Of the fourteen (14) non-participating dwellings with potential shadow flicker, the potential to experience shadow flicker will be below 30 hours per year for all dwellings.

Detailed desktop assessment of all non-participating dwellings with potential to experience shadow flicker has been included in ***Appendix E***.

Although there are no guidelines in the Bulletin relating to the acceptable level of shadow flicker on road users, shadow flicker has the potential to cause annoyance to commuters. The shadow flicker assessment identified extents of Black Stump Way, Orana Road, Wardens Road, Mount Hope Road and Moorefield Road which have the potential to experience shadow flicker.

ID	Shadow Hours per year:	Shadow Days per year:	Max Shadow Hours per day:	Assessment Notes:
5	24:06 / Year	91	0:21	Acceptable level (less than 30 hrs per year)
18	6:11 / Year	25	0:19	Acceptable level (less than 30 hrs per year)
25	12:00 / Year	49	0:20	Acceptable level (less than 30 hrs per year)
84	11:44 / Year	49	0:20	Acceptable level (less than 30 hrs per year)
85	11:21 / Year	48	0:19	Acceptable level (less than 30 hrs per year)
86	20:36 / Year	83	0:21	Acceptable level (less than 30 hrs per year)
88	26:23 / Year	100	0:21	Acceptable level (less than 30 hrs per year)
127	6:44 / Year	26	0:20	Acceptable level (less than 30 hrs per year)
151	6:45 / Year	27	0:19	Acceptable level (less than 30 hrs per year)
189	5:28 / Year	24	0:18	Acceptable level (less than 30 hrs per year)
190	7:16 / Year	28	0:20	Acceptable level (less than 30 hrs per year)
239	9:12 / Year	50	0:15	Acceptable level (less than 30 hrs per year)
324	6:07 / Year	26	0:19	Acceptable level (less than 30 hrs per year)
505	6:25 / Year	28	0:18	Acceptable level (less than 30 hrs per year)

Table 13. ***Non-participating dwellings with potential to experience shadow flicker***

11.0 Shadow Flicker & Blade Glint Assessment

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

All major wind turbine blade manufacturers currently finish their blades with a low reflectivity treatment. This prevents a potentially annoying reflective glint from the surface of the blades and the possibility of a strobing reflection when the turbine blades are spinning. Therefore the risk of blade glint from a new development is considered to be very low (Draft National Guidelines, 2010).

The turbines selected for the Project will be finished with a low reflectivity surface treatment in accordance with the requirements of the Bulletin.

12.0 Night Lighting Assessment

12.1 Overview of Night Lighting

The following section of the report provides an assessment of the visual impacts of potential night lighting of the Project. Night lighting has the potential to result in the alteration of the night time landscape character of the region. Potential light sources include:

- Aviation Hazard Lighting (AHL) on nacelle of wind turbines (height of up to 150 metres AGL)
- Night lighting for safety and security on ancillary structures.

12.2 Aviation Hazard Lighting

The requirement of aviation hazard lighting (AHL) on wind turbines for the Project is subject to the advice of the Civil Aviation Safety Authority (CASA). It is noted that the turbines proposed for the Project will possibly be up to 250 m in height and CASA generally recommends night lighting if an obstacle exceeds 150 metres above ground level.

Aviation Projects has undertaken a safety risk assessment of the Project and concludes that Turbines and Meteorological Masts ***will not require obstacle lighting to maintain an acceptable level of safety to aircraft***.

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.
- 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 (CASA, 2004).

As the intensity and location of proposed obstacle lights are relatively unknown at this stage, representative photomontages of the proposed obstacle lighting of the Project have not been included in this report.

Representative images of aviation lighting (installed in August 2020) on turbines at Biala Wind Farm have been included to best illustrate the potential visual appearance of aviation lighting. Photographs of the aviation lighting at varying distances and times have been included in this report.
Images 23 - 25 illustrate the effect of night lighting on a dark rural landscape at intervals after sunset.

Image 20. View towards Biala Wind Farm - 2.0 Kilometres from turbine at 6:20pm (30 minutes after sunset)

Image 21. View towards Biala Wind Farm - 1.75 Kilometres from turbine at 6:35pm (45 minutes after sunset)

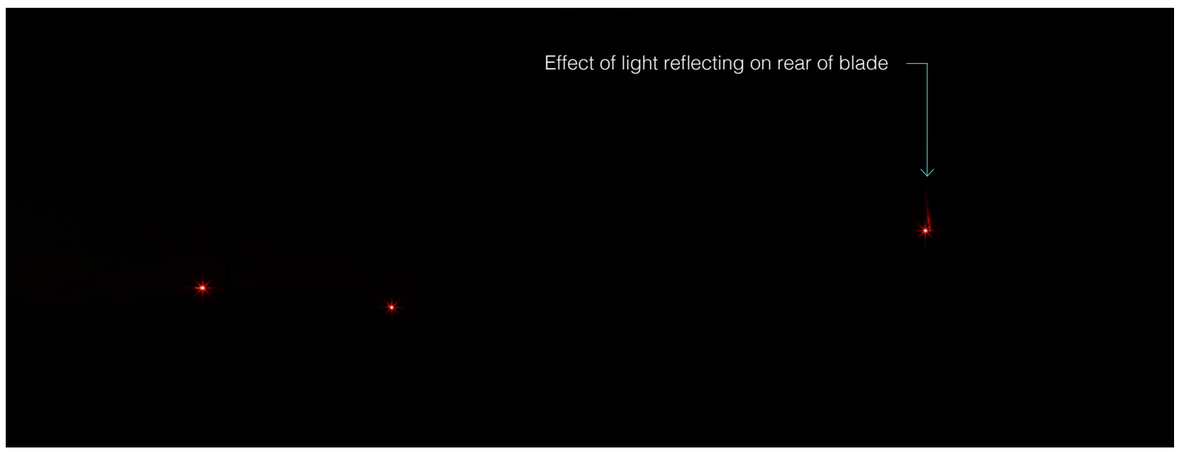


Image 22. View towards Biala Wind Farm - 1.85 Kilometres from turbine at 6:50pm (60 minutes after sunset)

12.0 Night Lighting Assessment

Image 23. View towards Biala Wind Farm - 3.5 Kilometres from turbine

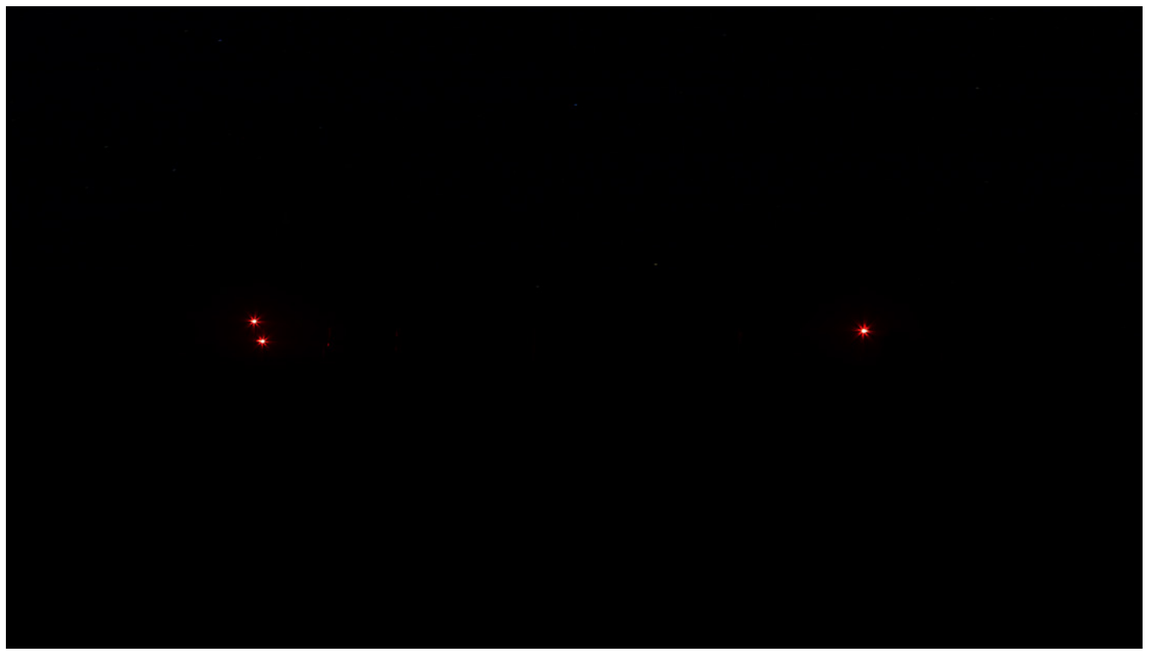


Image 24. View at night towards Biala Wind Farm - 3.5 Kilometres from turbine

Image 25. View towards Biala Wind Farm - 8.5 Kilometres from turbine

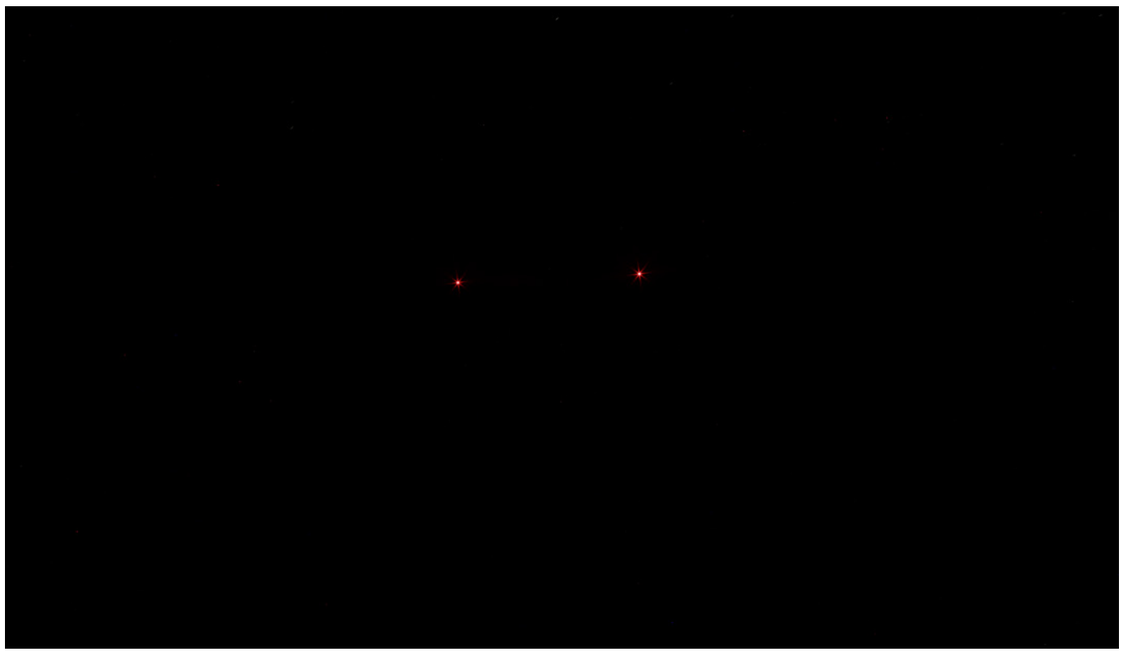


Image 26. View at night towards Biala Wind Farm - 8.5 Kilometres from turbine

12.0 Night Lighting Assessment

12.3 Dark Sky Planning Guidelines

The *Dark Sky Planning Guideline: Protecting the observing conditions at Siding Spring* adopted by the NSW Department of Planning and Environment in June 2016, provide guidance and technical information on good lighting design for development within 200 kilometres of the Siding Spring Observatory. The intent of the guideline is to ensure that lighting used in development does not impact on the effectiveness of the Observatory at Siding Spring.

The Siding Spring Observatory is located on the edge of the Warrumbungle National Park approximately 78 km north west of the Project Site. The Dark Sky Planning Guideline informs development controls that apply to the assessment of significant development within 200 kilometres of the Observatory.

The distance between the light source and the telescopes at the Observatory is the most critical factor in determining the level of artificial skyglow. The nearest turbine is 78 km from the Observatory and the furthest turbine is 102 km from the Observatory. The Dark Sky Planning Guideline, indicates 0-12 km and 12-18 km distance bands from the Observatory where particular lighting measures apply. On land beyond 18 km within the LGAs of Coonamble, Dubbo, Gilgandra and Warrumbungle a range of lighting measures apply and are set out in the relevant LEP.

The *Warrumbungle Shire Council Development Control Plan No. 1 : Lighting Code to protect Siding Spring Observatory* outlines light totalling 15,000 lumens or more on a development need to be assessed by the Director of the Australian National University research school of Astronomy and Astrophysics, or her delegate. As the exact extent of aviation lighting required for the Project is unknown at this stage, further assessment will be undertaken during the detailed design phase.

Principles outlined in the Dark Sky Planning Guideline will be considered to assist in protecting the night sky from artificial sky glow in the night sky attributable to light from human-made sources (refer to ***Section 12.6***).

12.4 Overview of potential visual impacts from Night lighting

Night lighting of turbines and associated infrastructure has the potential to extend the visual effect into the night time. Aviation hazard lighting has the potential to be visible from distances in excess of 20 kilometres (Scottish Natural Heritage).

Coolah is located 4.8 kilometres from the nearest turbine. If installed, aviation lighting has the potential to be a noticeable element in the night time landscape from areas around Coolah that have exposure to the views towards the Project Area. It is important to note the effect of night lighting is reduced when existing light pollution surrounds the viewer. Due to Coolah being a populated area, existing light sources from dwellings, buildings and street lights exist in the town.

Due to the relatively isolated location of the Project, very little existing sources of lighting are present in the night time landscape of the Study Area. Some existing lighting associated with homesteads and motor vehicles is dispersed around the Study Area. Isolated receptors within the Study Area experience a dark night sky with minimal light sources. The impact of night lighting is unlikely to be experienced from inside of a dwelling as internal lights reflect on windows and limit views to the exterior at night time.

The highest visual impact is likely to be people who experience the night landscape outdoors. Dark sky is a valued quality of the rural landscape, due to the lack of light pollution. Aviation lighting has the potential to impact on receptors who view the landscape at night, in particular night-sky enthusiasts, photographers, star gazers, campers and some land owners with potential visibility of the turbines hub.

Considering the high elevation of the turbines and the implementation of shields, the source of visible light is likely to be reduced to ambient lighting as opposed to direct visibility of the light itself when viewed from a close proximity.

The visual impact of potential aviation lighting could be reduced by employing mitigation methods outlined in ***Section 12.6***.

12.0 Night Lighting Assessment

12.5 Ancillary Infrastructure Lighting

In addition to aviation hazard lighting on wind turbines, night lighting may be required on ancillary infrastructure including switching stations, collector substations and temporary construction compounds and permanent Operations and Maintenance (O&M) buildings. At this stage of the project, the location and type of lighting required on the proposed substations and facilities buildings is yet to be confirmed. It is assumed the light sources are limited to low-level lighting for security, night time maintenance and emergency purposes. There will be no permanently illuminated lighting installed.

The proposed ancillary infrastructures have 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.

To reduce the potential visual impact of night lighting on ancillary structures the following should be considered:

- Security lighting throughout the wind farm, switching station and the substations should be minimised to decrease the contrast between the infrastructure lighting and the night time landscape of the area.
- Lighting is to be designed to ensure it does not spill onto nearby roads or residences.

In accordance with the Dark Sky Guideline, the following principles will be incorporated into lighting design during the detailed design phase of the switching station, substation, O&M Facility and any other ancillary structures requiring lighting:

- Only use lighting for areas that require lighting ie. paths, building entry points.
- Reduce the duration of lighting: Switch off lighting when not required.
- Consider the use of sensors to activate lighting and timers to switch off lighting.
- Use the lowest intensity required for the job.
- Use energy efficient bulbs and warm colours.
- Direct light downwards to eliminate.
- Ensure lights are not directed at reflective surfaces.
- Use non-reflective dark coloured surfaces to reduce reflection of lighting.
- Keep lights close to the ground and / or directed downwards.
- Use light shield fittings to avoid light spill.

If the above design principles are incorporated into the night lighting for Ancillary Infrastructure, it is likely the visual impacts resulting from night lighting of Ancillary Structures would be negligible.

12.6 Aviation Lighting Design Principles

The Bulletin states: *If such lighting is required, the CASA guidelines recommend that to minimise visual impacts "obstacle lights may be partially shielded, provided it does not compromise their operational effectiveness. Where obstacle lighting is provided, lights should operate at night, and at times of reduced visibility. All obstacle lights on a wind farm should be turned on simultaneously and off simultaneously." The lights should be fully shielded from the view of any dwelling within. As part of the assessment of visual impacts of wind energy projects, the Department will consider whether any obstacle lighting required is likely to result in any significant increase in visual impacts.*

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 is required to be spaced over the array, particularly at the extremities. They are not required on every tower. Where possible, careful consideration of turbines upon which aviation lighting is installed to avoid unnecessary impact upon residences.
- Treatment of the rear of blades with a non-reflective coating to reduce reflection off the rotating blade at night.
- Use of the lowest candela intensity allowed by CASA.
- 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 25***).
- No light should be emitted at or below 10° below horizontal.

Technology in both aviation and wind farm development is constantly evolving. One example of evolving technology is Air Detection Lighting System (ADLS). Although these haven't been utilised in New South Wales, an ADLS has recently been installed at the Lal Lal Wind Farm just east of Ballarat in Victoria. An ADLS is an effective measure to reduce visual impacts, save electricity and improve aviation safety. Aviation lighting is activated when an aircraft approaches within four to six kilometres.

As this technology such as Air Detection Lighting Systems become more cost effective and readily available, it may become viable option for the Project.

Overtime as wind farm development has occurred throughout New South Wales, there are precedents for the review of the requirement of aviation lightings on a number of wind farms post-construction. In the Upper Lachlan Shire, on November 1, 2010 Cullerin Wind Farm, owned by Origin Energy, switched off turbine aviation lighting after guidelines set out by CASA were withdrawn. Requirement of aviation lighting for Crookwell 2 Wind Farm was reviewed by CASA in 2019 and allowed to be turned off (McCabe, 2019).

12.0 Night Lighting Assessment

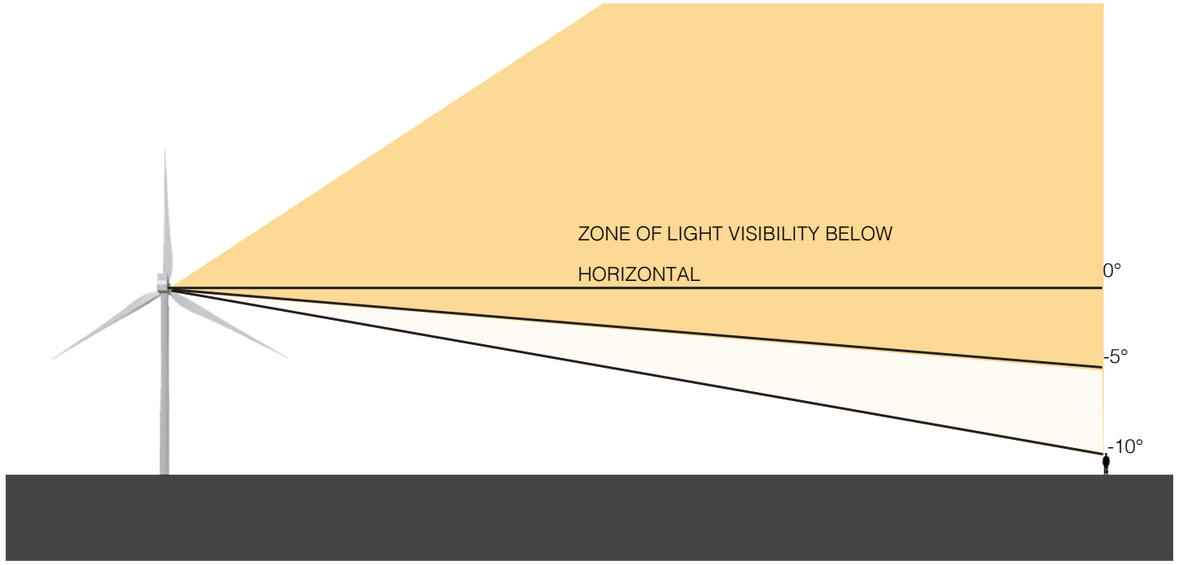


Figure 25** **CASA Recommended Obstacle Lighting Spread (Image adapted from Urbis 2009)

12.7 Associated Infrastructure Lighting Design Principles

The following recommendations have been developed with consideration of the principles outlined in relevant best practice guidelines for lighting design.

The Dark Sky Planning Guidelines have been developed by the Department of Planning and Environment (June 2016) provide guidelines for lighting practices that support the maintenance of a dark sky and improve lighting practice. The guidelines are related to projects within 200 kilometres of the Siding Spring Observatory, however they provide relevant guidance to reduce potential light pollution can be applied to lighting design for the Ancillary Infrastructure for the Hills of Gold Wind Farm.

The Australian Government Department of the Environment and Energy, National Light Pollution Guidelines for Wildlife: Including marina turtles, seabirds and migratory shorebirds, January 2020 Version 1.0 may also be considered during the detailed design phase.

The following principles will be incorporated into lighting design during the detailed design phase of the switching station, substation, O&M Facility and any other structures requiring lighting. If design principles are incorporated into the night lighting for Ancillary Infrastructure, it is likely there will be no visual impacts resulting from night lighting of Ancillary Structures.

1. Control the level of lighting:

- Only use lighting for areas that require lighting ie. paths, building entry points.
- Reduce the duration of lighting:
    - Switch off lighting when not required
    - Consider the use of sensors to activate lighting and timers to switch off lighting

2. Lighting Design:

- Use the lowest intensity required for the job
- Use energy efficient bulbs and warm colours
- Direct light downwards to eliminate
- Ensure lights are not directed at reflective surfaces
- Use non-reflective dark coloured surfaces to reduce reflection of lighting (**Figure 26**)
- Keep lights close to the ground and / or directed downwards (**Figure 27**)
- Use light shield fittings to avoid light spill (refer to **Figure 28**).

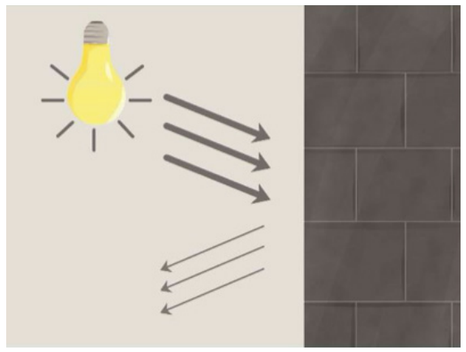


Figure 26. Surface Reflectivity
Source: Department of Environment and Energy National Light Pollution Guidelines for Wildlife (2020)

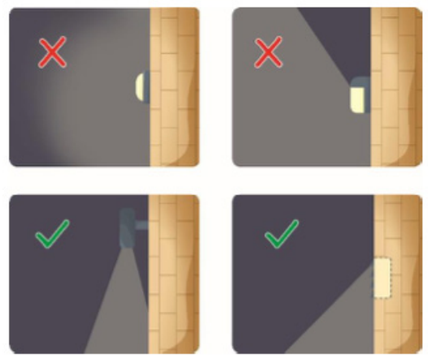


Figure 27. Downward Lighting
Source: Department of Environment and Energy National Light Pollution Guidelines for Wildlife (2020)

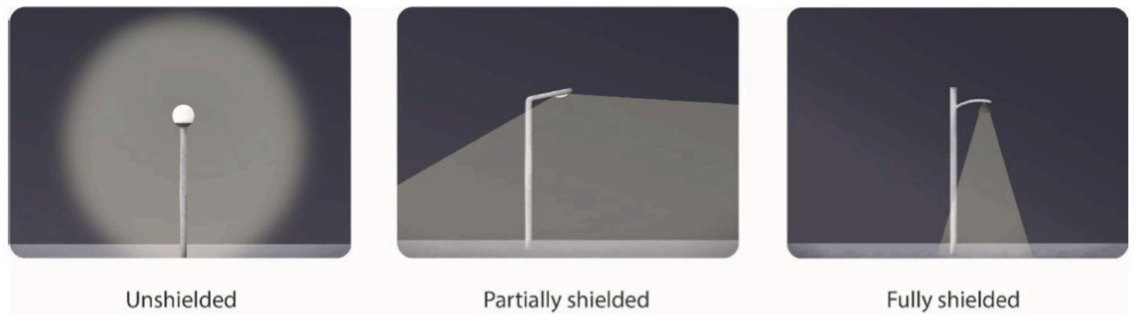


Figure 28. Light Shielding
Source: Department of Environment and Energy National Light Pollution Guidelines for Wildlife (2020)

13.0 Cumulative Visual Impact Assessment

13.1 Overview of Cumulative Visual Impacts

The Bulletin states: *The visual assessment must assess, in accordance with the SEARs, the overall and broader landscape impacts of the proposed wind energy project. It will also address potential cumulative impacts of wind energy projects in the region (the proposed wind energy project, as well as existing and approved projects).*

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 Project considers the potential cumulative effects on the immediate and broader regional context it forms part of.

A cumulative impact assessment 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.

13.2 Nearby Wind Farm Projects

The Project is located within the Central-West Orana Renewable Energy Zone (REZ). The REZ has been identified by the NSW Governments Electricity Strategy. The REZ is expected to play a vital role in delivery of affordable energy to the community across NSW (Energy NSW, 2021).

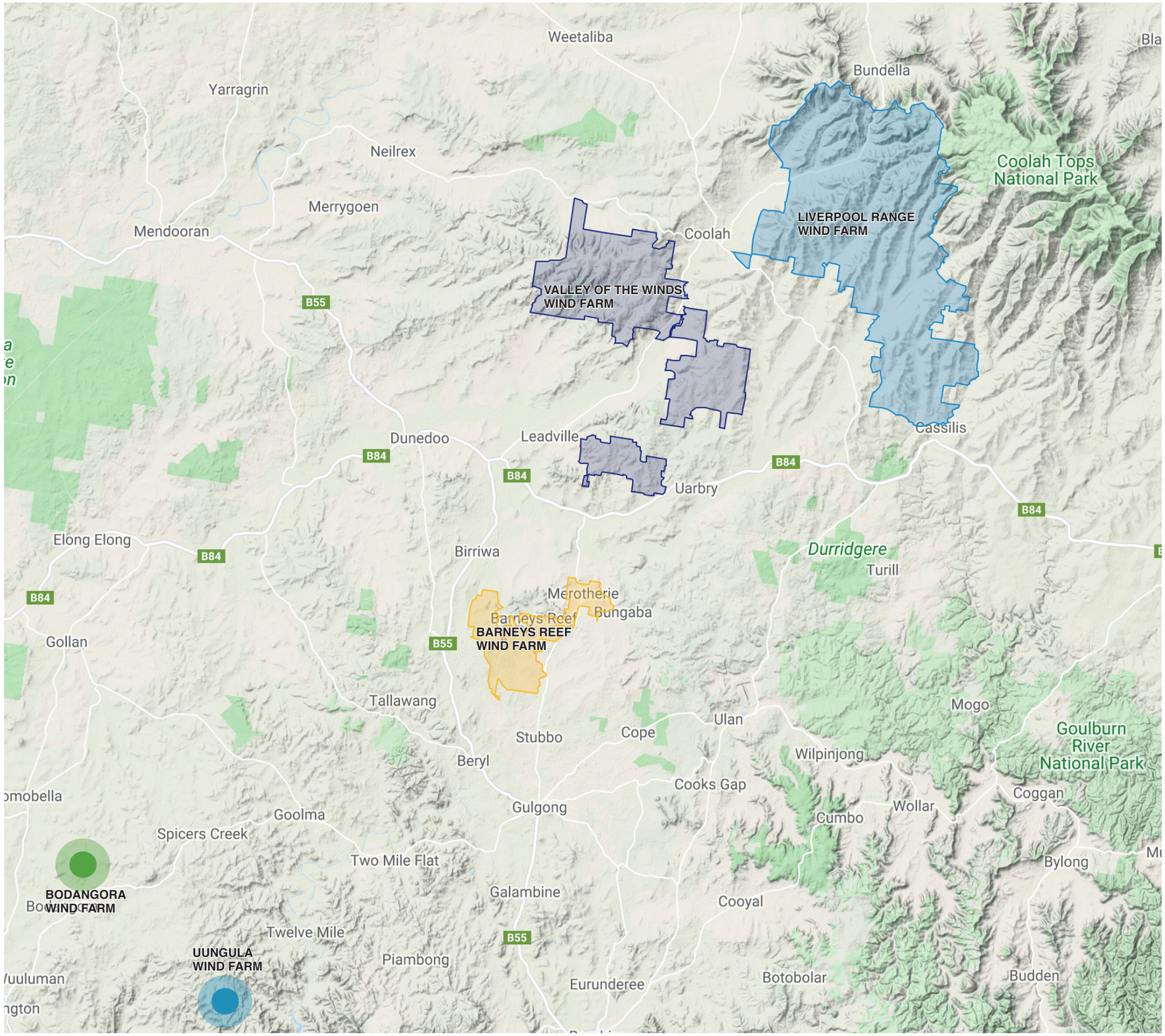
A total of seven (7) proposed, approved and constructed wind farms are located within 100 kilometres of the Project. These are listed in ***Table 14*** and those nearby are shown on ***Figure 29.*** A detailed assessment of the potential cumulative visual impact has been undertaken for Liverpool Range Wind Farm which is located approximately 10 kilometres northeast of the Project.

Project	Distance to nearest turbine	Project Size *Estimated	Planning Status
Operational Wind Farms			
Crudine Ridge Wind Farm	***> 90 km south***	***37 turbines***	Operational
Bodongara Wind Farm	***60 km southwest***	***33 turbines***	Operational
Approved Wind Farms			
Liverpool Range Wind Farm	***10 km northeast***	****267 turbines***	Modification to consent
Uungala Wind Farm	***65 km southwest***	****97 turbines***	Consent granted: May 2021
Proposed Wind Farms			
Barneys Reef Wind Farm	***11 km south***	****65 turbines***	SEARs issued: September 2021
Burrendong Wind Farm	***70 km south***	****96 turbines***	SEARs issued: October 2020

Table 14. Summary of nearby Wind Farm Projects

*Note: Information available on NSW Major Project Database accessed Febuary 2022.

13.0 Cumulative Visual Impact Assessment



Nearby Wind Farms

LEGEND

- Valley of the Winds Wind Farm Site
- Liverpool Range Wind Farm (Modified Project)
- Barneys Reef Wind Farm (SEARS issued)
- Operational Wind Farm
- Approved Wind Farm

N

***Figure 29** Nearby Wind Farm Projects (Map Source: Google Maps)*

13.0 Cumulative Visual Impact Assessment

13.3 Cumulative Impact of Modified Liverpool Range Wind Farm (LRWF)

The Liverpool Range Wind Farm (LRWF Project) gained development consent in March 2018, for 267 turbines with a blade tip height of up to 165 metres. A modification has been made to the approved layout and a consent is being lodged for reducing the number of wind turbines to 217 and increasing the turbine height to 250 metres. The LRWF Project is sited south west of the Coolah Tops National Park. The nearest turbine is 10.38 kilometres northwest of the Valley of the Winds (VOTW) Project's turbine which belongs to the Girragulang cluster (turbine GR12). Due to the relatively close proximity of the LRWF to the VOTW Project, a detailed assessment of the potential cumulative visual impact has been undertaken.

To assist in the cumulative visual impact assessment, a Zone of Visual Influence (ZVI) has been prepared to illustrate areas from which there is the potential to view both Projects (based on topography alone). The Zone of Visual Influence demonstrates areas of land from which turbines associated with the LRWF Project, VOTW Project or potential to view both Projects simultaneously. Refer to ***Figure 30.***

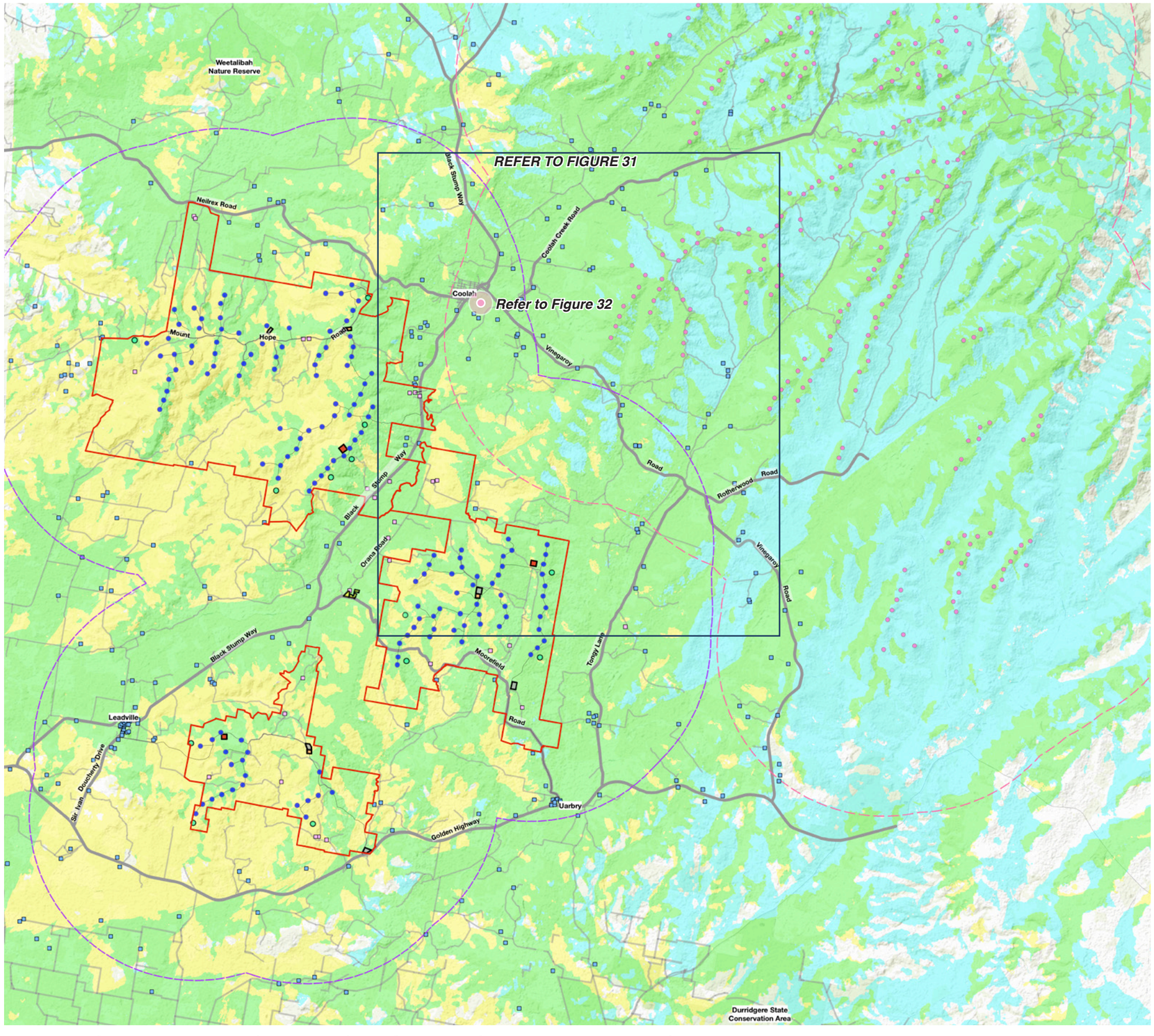


Figure 30** Cumulative **Zone of Visibility (Map Source: ESRI Topographic Maps)

Cumulative Zone of Visibility

Valley of the Winds Wind Farm

LEGEND

- Project Boundary
- Proposed 250 m Valley of the Winds wind turbine location
- Liverpool Range Wind Farm wind turbine location (not yet approved)
- Participating Dwelling
- Non-Participating Dwelling
- 8000m from Valley of the Winds wind turbine
- 8000m from Liverpool Range Wind Farm wind turbine
- Major roads / highways
- Minor roads
- Location of representative cumulative Photomontage

  (Refer to ***Figure 30A & 30B*** and ***Photomontage 7A & 7B - Appendix D***)

ZVI Legend:

- No visibility areas
- Valley of the Winds Wind Farm
- Liverpool Range Wind Farm
- Valley of the Winds Wind Farm and Liverpool Range Wind Farm

Note:

The ZVI is a preliminary assessment tool that represents a bare ground scenario - ie. a landscape without screening, structures or vegetation. 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.

N

0 2 4 6 8 10km

13.0 Cumulative Visual Impact Assessment

13.3.1 Assessment of Non-participating Dwellings

17 non-participating dwellings are located within 8 kilometres of both the LRWF and VoW Projects. Eight (8) of these non-participating dwellings were identified in accordance with the *Preliminary Assessment Tool: 2 Multiple Wind Turbine Tool* (Refer to ***Section 6.4***), as having potential to view turbines associated with the Project in more than three (3) 60 degree sectors. Refer to **Figure 31.**

A summary of the potential cumulative visual impacts on the eight (8) non-participating dwellings with more than three (3) sectors identified has been provided in ***Table 15.***

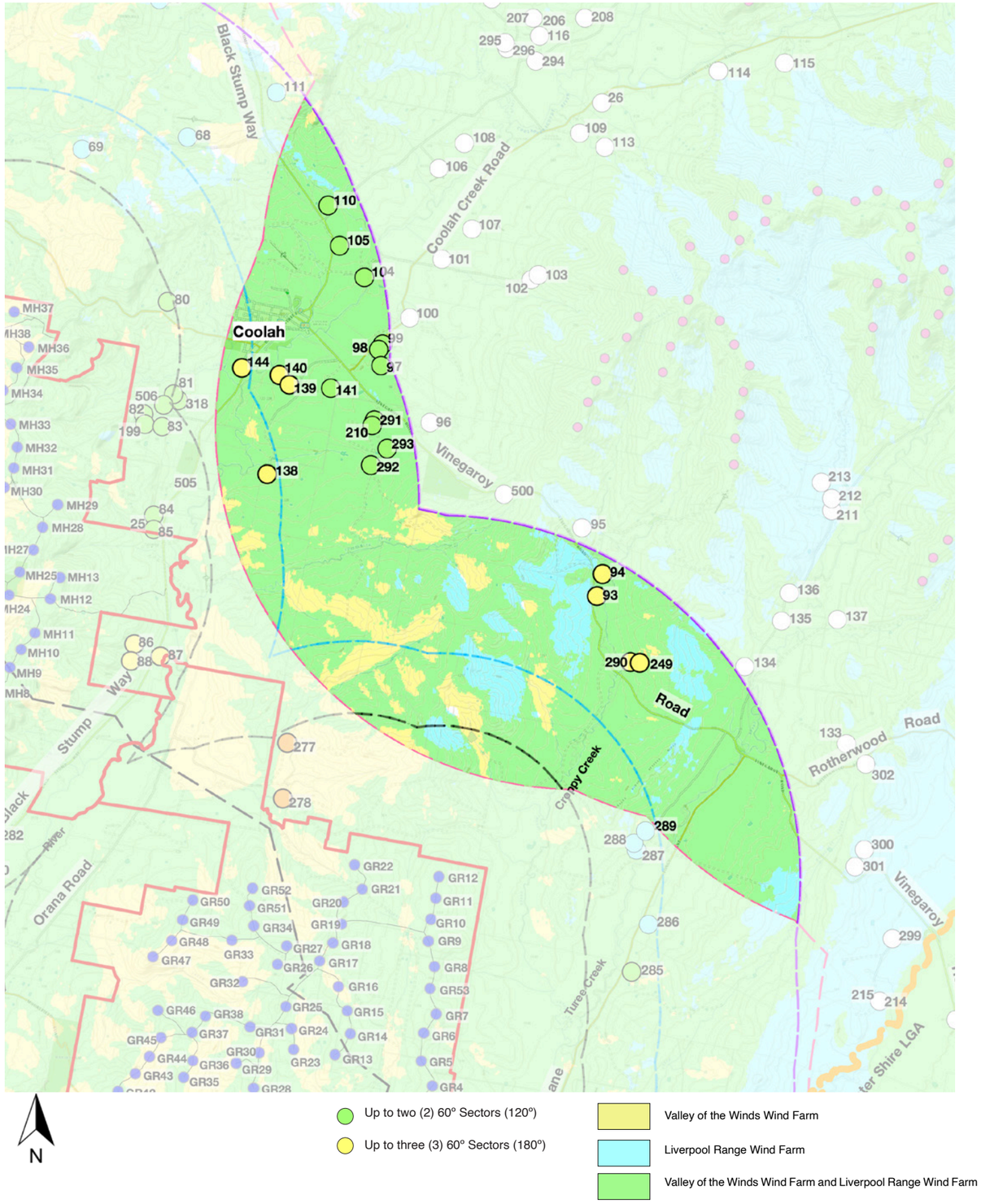


Figure 31** Cumulative **Zone of Visibility - Area within 8,000m of VoW & LRWF Projects

13.0 Cumulative Visual Impact Assessment

Overview of Cumulative Visual Impacts on Non-participating Dwellings:					
Distance to nearest VoW turbine:	Distance to nearest LRWF turbine:	Number of VoW turbines visible:	Number of 60° sectors with turbines (Based on assessment):	Cumulative Visual Impact Rating:	Assessment Notes:
Dwelling 93: *'Willandra', Vinegaroy Road, Coolah*					***Dwelling 93 Assessment Notes:***
7.12 km (GR12)	***3.74 km***	***Nil***	***Nil***	***Nil***	Aerial imagery indicates Dwelling 93 is surounded by dense screening vegetation. Views to the VoW Project will be screened by the dense vegetation to the west of the dwelling. It is anticipated there will be no visibility towards the VoW Project and therefore no ciumulative visual impact from this dwelling.
Dwelling 94: *Vinegaroy Road, Coolah*					***Dwelling 94 Assessment Notes:***
7.60 km (GR12)	***3.27 km***	***Nil***	***Nil***	***Nil***	Aerial imagery indicates Dwelling 94 is surounded by dense screening vegetation. Views to the VoW Project will be screened by the dense vegetation to the west of the dwelling. It is anticipated there will be no visibility towards the VoW Project and therefore no ciumulative visual impact from this dwelling.
Dwelling 138:					***Dwelling 138 Assessment Notes:***
4.69 km (MH29)	***6.92 km***	***Approx. 26***	***Two (2)***	***Low***	Aerial imagery indicates Dwelling 138 is orientated towards the north. Turbines associated with the VoW Project with potential visibility (based on an assessment of topography alone) are located to the east of the dwelling. Views to the LRWF Project are in excess of 6 km to the west of the dwelling. Existing structures visible on the aerial imagery are anticipated to screen views to a large portion of the VoW Project, reducing the potential visibilty to two (2) sectors from this dwelling, which is deemed acceptable.
Dwelling 139: *'Mianga' Oban Road, Coolah*					***Dwelling 139 Assessment Notes:***
5.77 km (MH29)	***6.42 km***	***Approx. 33***	***Two (2)***	***Low***	Aerial imagery indicates Dwelling 139 is orientated towards the north towards the township of Coolah. Turbines associated with the VoW Project with potential visibility (based on an assessment of topography alone) are located to the north east and east of this dwelling. Turbines associated with the LRWF Project are located to the north west and west of this dwelling (in excess of 6 kms). Existing shed and vegetation to the east of the dwelling is likely to fragment views to the VoW Project from this dwelling. If deemed neccessary, additional screen planting to the east would reduce the visibility of the VoW Project and subsequently reduce the potential cumulative visual impact.
Dwelling 140: *'Oban' Oban Road, Coolah*					***Dwelling 140 Assessment Notes:***
5.57 km (MH36)	***6.68 km***	***Nil***	***Nil***	***Nil***	Aerial imagery indicates Dwelling 140 is surounded by screening vegetation. Views to the VoW Project will be screened by the dense vegetation to the east of the dwelling. It is anticipated there will be no visibility towards the VoW Project and therefore no ciumulative visual impact from this dwelling.
Dwelling 144:					***Dwelling 144 Assessment Notes:***
4.73 km (MH36)	***7.52 km***	***Approx. 73 @ hub***	***Two (2)***	***Low***	Aerial imagery indicates Dwelling 144 orientated to the north towards surounded by screening vegetation. Views to the VoW Project are likely to be fragmented by vegetation to the south of the dwelling. Views to the LRWF Project are likely to be fragmented to the east. The resulting cumulative visual impact is likely to be low due to the intervening vegetation and distance to the turbines.
Dwelling 249: *Vinegaroy Road*					***Dwelling 249 Assessment Notes:***
6.49 km (GR12)	***4.83 km***	***Approx.***	***Nil***	***Nil***	Aerial imagery indicates Dwelling 249 is surounded by dense screening vegetation. Views to the VoW Project will be screened by the dense vegetation to the south west of the dwelling. It is anticipated there will be no visibility towards the VoW Project and therefore no ciumulative visual impact from this dwelling.
Dwelling 290: *Vinegaroy Road*					***Dwelling 290 Assessment Notes:***
6.35 km (GR12)	***4.90 km***	***Approx. 45***	***One (1)***	***Nil***	A desktop assessment undertaken for Dwelling 290 indicates views to the LRWF turbines will be screened by vegetation. Views to the VoW Project are likely to be available, however fragmented by vegetation. There would be no resulting vcumulative visual impact from this dwelling.

Table 18. ***Summary of Cumulative Impacts on Non-participating Dwellings***

13.0 Cumulative Visual Impact Assessment

13.3.2 Assessment of Public Viewing Locations

Due to the undulating landscape character, there are limited opportunities to view both Projects simultaneously from publicly accessible locations.

Black Stump Way:

The Cumulative ZVI indicates views to both the VoW and LRWF Project will be available travelling north along Black Stump Way. Generally, views to LRWF will be distant occupy a very small portion of the view to the north.

Tongy Lane:

The Cumulative ZVI indicates areas along Tongy Lane may have views to both the VoW and LRWF Projects. Views from Tongy Lane to the VoW Project are largely contained to the GR Cluster of the VoW Project. Views to the LRWF Project will visible in the distance in excess of 8 kilometres. Localised vegetation is likely to fragment views to the distant turbines.

Vinegaroy Road:

The Cumulative ZVI indicates views to both Project may be available from Vinegaroy Road and associated dwellings. Vinegaroy Road, on the other hand, meanders through a valley that is bordered by gentle to moderately steep undulations which limit views to the direction of travel along this road. Certain elevated positions have the potential to view both Projects, however, vegetation plays an important role in screening views at such locations. It is anticipated that the extent of visibility would change as travellers move through the landscape, and views to the Project would be limited in parts by topography.

Coolah Township:

The Cumulative ZVI indicates views to both the VoW and LRWF Projects would be available from the town of Coolah. Although Coolah is located at a higher elevation, the town's undulating character and dense vegetation corridors help screen many views towards both Projects (see **Image 27**). Residential and commercial buildings also play an important role in screening views. The road layout within the township of Coolah is largely orientated to the east - west and north - south. Views towards the VoW Project from roads orientated to the east will likely to limited by intervening residences and associated vegetation. Views to VoW Project are likely to be available in the distance along streets with south orientation (see **Image 28**). Visibility of the MH Cluster will be highest from the dwellings and public land to the south of the township. Further detailed assessment of the township has been undertaken through viewpoint analysis.

The ZVI indicates opportunities to view the Project from some of the southern-most locations within the town of Coolah. A Photomontage has been prepared from the Collaburragundy River walking track that runs adjacent to the Cunnigham Caravan Park (refer to ***Figure 32***).

There are limited opportunities to view both Projects simultaneously. Where views to both projects are available the Projects are likely to be distant and there are no opportunities to view both projects in their entirety from any viewpoints within the Study Area.

Image 27. Example of contained views from Binnia Street, Coolah (south)

Image 28. View to the south from Queensborough Road, Coolah.

13.0 Cumulative Visual Impact Assessment

Figure 32 (A) Photomontage - Cumulative Visual Impact from Coolaburragundry River Walk, Coolah

Extent of LRWF Project

Note: Nearest turbine in excess of 6km

Extent of VoW Project

Note: Nearest turbine MH36: 5.43 kms

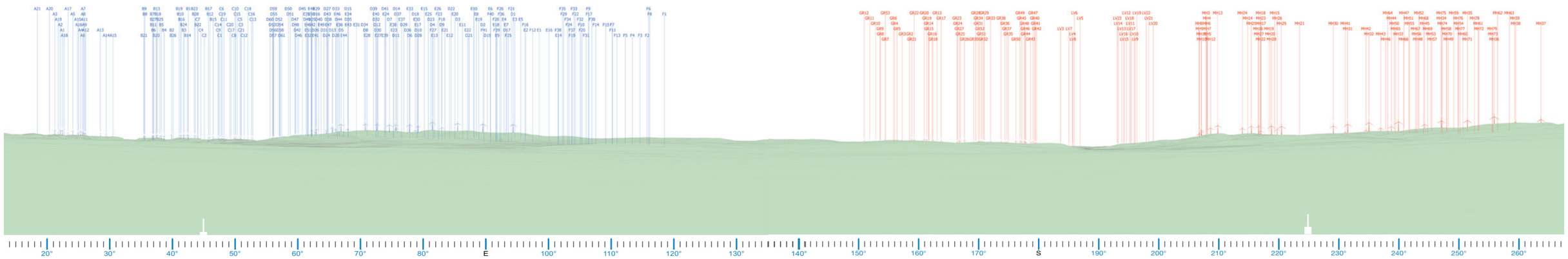


Figure 32 (B) Wire Frame Diagram - Cumulative Visual Impact from Coolaburragundry River Walk, Coolah

13.0 Cumulative Visual Impact Assessment

13.4 Cumulative Impact on the Broader Landscape Character

The New South Wales Government have identified three (3) key Renewable Energy Zones (REZ) in the State's Central-West Orana, New England and South-West regions. The Project is located almost on the western edge of the land defined as the Central-West Orana REZ. The existing landscape character of the region allows for optimum harvest of wind energy due to elevated and undulating 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 for the development of wind farm projects.

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 effect of multiple wind farms and other major infrastructure within the region would combine to become the dominant visual element, altering the perception of the general landscape character.

The potential cumulative visual impact must also consider 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 Project clusters are located on ridgelines that are surrounded by scattered dwellings and setback from Major Travel Corridors. As there are limited opportunities to view both the Project simultaneously, it is unlikely the perception of the regions broad landscape character will be altered as a result of the Valley of the Winds Wind Farm Project.

14.0 Associated Infrastructure Assessment

14.1 Overview of Associated Infrastructure

In addition to the proposed wind turbines, the associated infrastructure (as described in ***Section 3.4*** of this report) is likely to contrast with the existing visual landscape. Due to the large scale and elevated siting of the proposed wind farm, access roads, transmission lines 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.

14.2 Access Roads

Access roads are proposed off site connecting to existing arterial roads, and on site between the wind turbines. Access to the three components of the Project is proposed via Mount Hope Road for the Mount Hope cluster, Moorefield Road for the Girragulang cluster and Sir Ivan Doucherty Drive for the Leadville cluster. Currently these roads convey moderate truck traffic and it is likely some upgrades to these roads would be completed to accommodate the Project.

The construction and maintenance of the Project will require construction of approximately 137 kilometres of private access roads. Civil engineering concept designs identified the most suitable location for roads and hardstands to avoid earth works where practicable. The benefits this brings to the Project is that the ancillary infrastructure is integrated into the existing contours where possible. Where possible, the internal road network will be aligned on the route of existing farm or other access roads. The internal roads will be up to six (6) metres wide excluding drainage with localised widening where required to support transportation of the WTG components.

Generally, the internal 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 traversing 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 for reducing residual visual impact resulting from the construction of access roads include:

- *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.*

14.3 Transmission Lines

14.3.1 Internal 33kV Transmission lines

Each of the WTG clusters will be internally connected to an onsite substation via 33kV underground electrical cables. If required, any overhead transmission lines are likely to be located adjacent to the footprint of internal access roads.

14.3.2 External Transmission lines

A overhead transmission line (up to 330kV) is proposed to dispatch electricity from each cluster. This network will connect the on site substations to an overhead 500kV transmission line which will connect the Project to the Central-West Orana REZ Transmission line. The 330kV transmission line will connect to the overall Central-West Orana Transmission line to feed into the larger grid. The proposed 330kV transmission line is typically 50 metres high. A 60 cleared easement will be required underneath the transmission line. ***Figure 25*** provides an overview of the potential visual impacts resulting from the construction of the 330kV transmission lines.

Generally the above ground transmission lines transverse a large area of uninhabited land surrounded by undulating topography. Opportunities to view the transmission lines are limited due to distance, topography and vegetation.

Proposed mitigation methods to be considered during detailed design phase include:

- *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.*

14.0 Associated Infrastructure Assessment

14.4 Ancillary Structures

14.4.1 Substation and Step-up Facilities

There would be one ‘collector’ substation in each of the Mount Hope and Leadville clusters, and one ‘central’ substation within the Girragulang Road cluster. The locations of the proposed substations have been selected to ensure minimal visual impacts. The substations are generally located within the project boundary and set back from nearby dwellings and publicly accessible roads. If deemed necessary during the detailed design phase, mitigation methods such as screen planting could be employed to reduce any potential visual impacts.

One (1) Step-up facility will be required at the connection to the Central-West Orana Transmission Line. The footprint is likely to be approximately 100 x 100 metres at a height of up to 20 m.

14.4.2 Site Operations and Maintenance Facility (O&M)

An Operations and Maintenance Facility (O&M Facility) would be expected to be approximately 100 metres by 100 metres (one hectare in area) and there would be one located in each cluster. Each operation and maintenance facility would generally comprise a control room (offices, monitoring equipment, stores and amenities), storage and maintenance facilities, laydown areas, and parking. The height of the O&M Facility is likely to be approximately 5 m. The O&M Facilities are proposed to be located within the project boundary, set back from non-participating dwellings and publicly accessible roads.

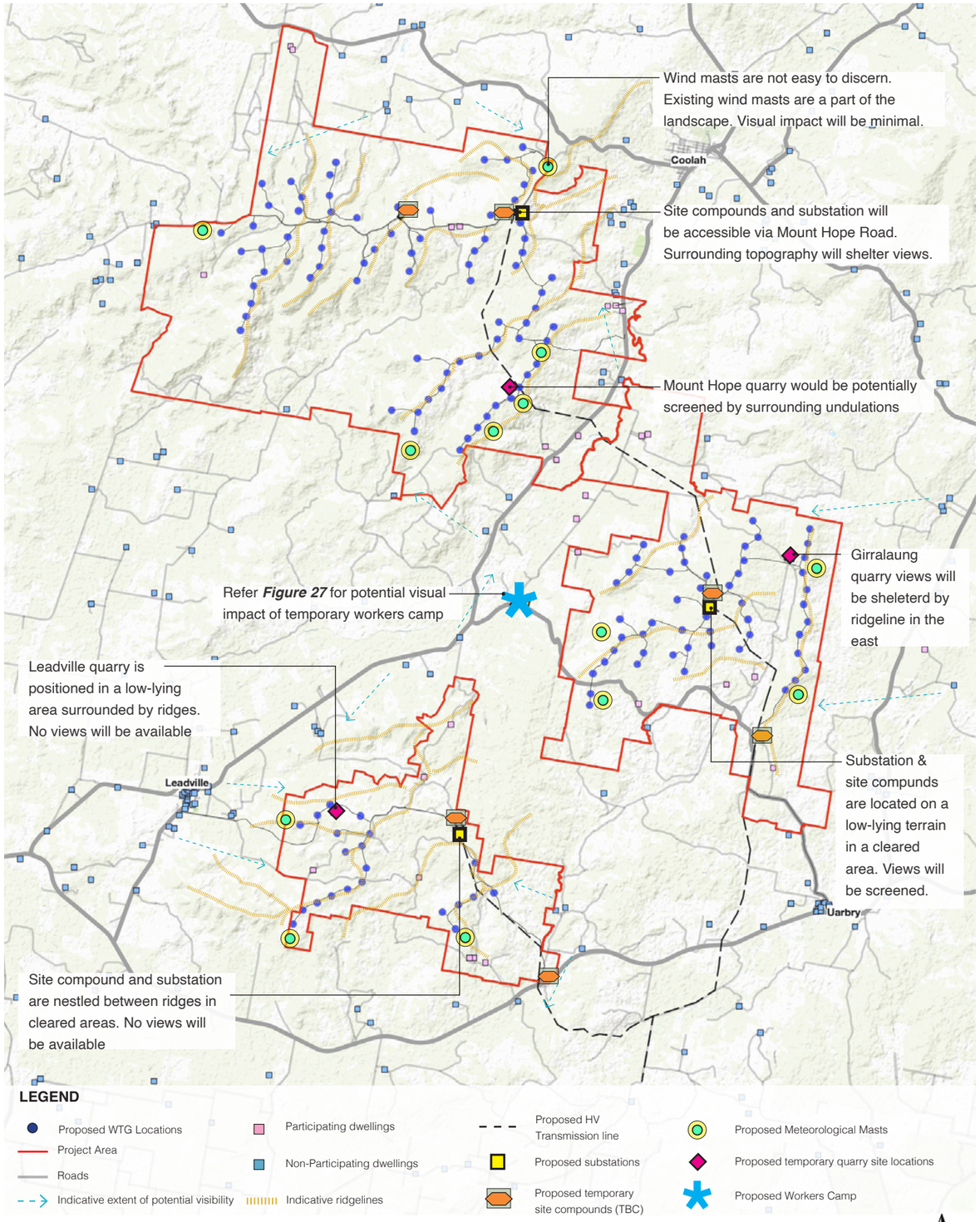


***Figure 33* Overview of Potential Visual Impacts - Associated infrastructure**
(Map Source: ESRI Topographic Maps)

14.0 Associated Infrastructure Assessment

Image 29. Example of a building colour palette sympathetic to the surroundings

Image 30. Example of landscape screening along the boundary of a substation - Rothbury NSW

The smaller scale of ancillary structures including the proposed substation and site compound have the ability to be screened by topography, existing vegetation or proposed screening vegetation. The following mitigation measures would assist in reducing any residual visual impacts:

- *Siting to ensure minimal vegetation loss.*
- *Screen planting to further reduce any residual visual impacts.*
- *Consideration should be given to controlling the type and colour of building materials used. Where possible a recessive colour palette is to be used which blends into the existing landscape (see example provided in* ***Image 29****).*
- *Avoidance of unnecessary lighting, signage on fences, logos etc.*
- *Any proposed buildings to be sympathetic to existing architectural elements in the landscape.*
- *Minimise cut and fill and loss of existing vegetation throughout the construction process.*
- *Boundary screen planting 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 30****.*

14.4.3 Meteorological Monitoring Masts

The Project includes decommissioning of two (2) current monitoring masts and installation of up to thirteen (13) new monitoring masts for power testing. Of these, 6 masts will be associated with the Mount Hope cluster, 4 masts will monitor for the Girragulang cluster and 3 masts for the Leadville cluster. The thirteen (13) monitoring masts will be located close to a WTG location and will have same height as the WTG hub height. The exact number and location will be defined at the detailed design stage. The existing masts are difficult to discern from a distance and are an existing element in the landscape.

14.5 Temporary construction facilities

14.5.1 Site Construction Compounds & Quarry Sites

A total of three (3) quarry sites have been proposed to obtain rocks for building access tracks and hardstands around the Project Area as shown in ***Figure 31***. Each of these quarries will serve the three clusters and will be potentially located in close proximity of the turbines. They have been sited in areas that are currently utilised for grazing and are void of any vegetated woodlands, thus eliminating the need for tree removal. The proposed sites are surrounded by undulations which will limit all views towards these sites.

14.0 Associated Infrastructure Assessment

Site construction compounds to serve each of these clusters will also be established temporarily during construction. Potential construction compounds will be located within the extents of the three clusters near the proposed HV transmission line (see ***Figure 33***). Views to the compounds are also likely to be sheltered by surrounding undulations associated with each cluster.

14.5.2 Temporary accommodation for workforce

In addition to the above mentioned temporary infrastructure components, a propsoed workers camp will be built to accommodate the workforce during construction phase. Temporary accommodation for up to 400 workers will be located at the corner of Moorefield Road and Girragulang Road over an area of 11 ha as show in ***Figure 34***. The location of this camp is central to the Project and will provide easy access to the three (3) Project Clusters.

The temporary worker accommodation will comprise of approximately 500 rooms in an area of 3.7 ha. The single storey mobile camp's exact number of rooms, orientation and location will be developed at detail design stage. Examples of these mobile cabins have been depicted in ***Images 31 - 34***. The temporary facility is sited on land that belongs to participating dwelling 307 which is located north of the proposed site. The surrounding landscape is generally flat with minor undulations and moderately dense vegetation in the east. Land parcels to the west of the dwelling are currently utilised for non-intensive dryland cropping. Views from dwelling 307 are likely to screened by the trees that are located in the south/southeast direction.

Moorefield Road and Girragulang Road are low use roads that are generally used to access scattered rural dwellings and farmlands located at the foothills of undulations associated with Girragulang cluster. It is highly likely that the views for commuters that use these roads will be screened by existing roadside vegetation.

The nearest non-participating dwelling is dwelling 501 which is located 1.7 km west of the proposed workers camp. Dwelling 501 is surrounded by dense windbreak vegetation which will inhibit views in all directions. Dwelling 185 is located approximately 2 km southwest of the proposed workers camp. Although the dwelling is not surrounded by vegetation, the distance of the dwelling from this camp will not allow clear or distinct views of the worker cabins. The resultant visual impact is, therefore, low.

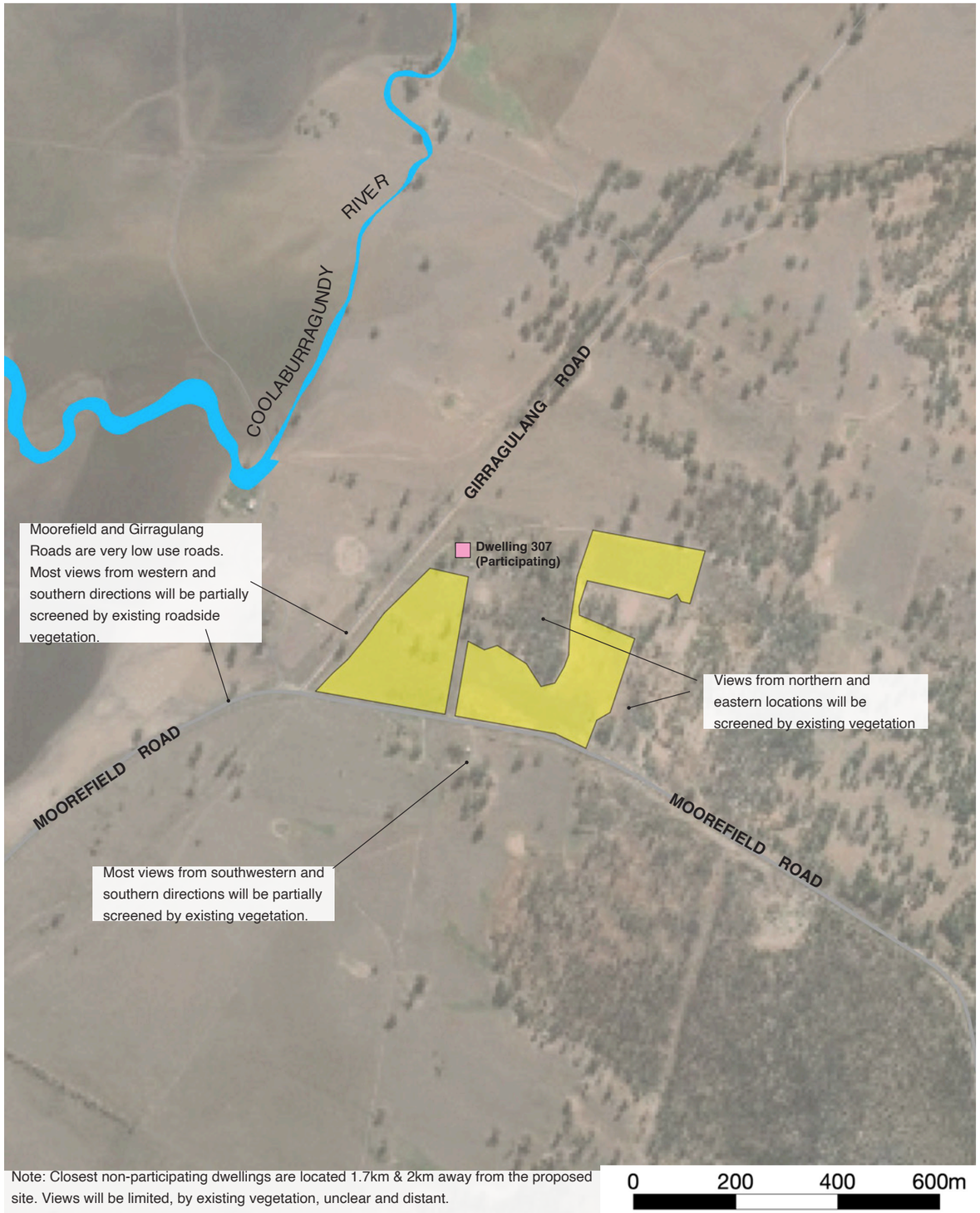


Figure 34 ***Overview of Potential Visual Impacts - Workers Camp***
(Map Source: ESRI Aerial Imagery)

14.0 Associated Infrastructure

Image 31 Typical aerial view of tempoary workers accommodation (Source: Ausco Modular Pty Ltd)

Image 32 Workers cabins: typically single storey with nude tones (Source: Ausco Modular Pty Ltd)

Image 33 Surrounding vegetation can limit views of single storey cabins (Source: Ausco Modular Pty Ltd)

Image 34 Typical facilities include single storey cabins & passive recreational areas (Source: Ausco Modular Pty Ltd)

15.0 Visual Impacts on Landscape Character

15.1 Overview of Visual Impacts on Landscape Character

The proposed development is to be located within a predominantly rural landscape that has not been identified as significant or rare. The broad landscape character is dominated by established rural land which consists primarily of modified undulating hills. Generally, the Scenic Quality Classes of the Landscape Character Units (LCU) within the Study Area have been rated as low with some areas defined as moderate (refer to ***Section 5.8***).

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 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.

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. Regionally, significant landscape features identified in ***Section 5.6*** 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.

15.2 Overview of the Visual Impact on LCUs

Appendix B 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 5.8*** of this report. An evaluation of the potential visual impacts has been undertaken using the visual performance objectives as outlined in the Bulletin.

Table 19 provides a brief summary of the findings.

Of the five (5) LCU's identified and assessed, the Project is likely to be visible from all, to varying degrees. Due to the undulating topography surrounding the Project Area, there are limited opportunities to view the Project in its entirety.

15.0 Visual Impacts on Landscape Character

Summary of Visual Impacts of Landscape Character Units			
LCU:	**Scenic Quality Rating:**	**Landscape Scenic Integrity:**	**Key Landscape Features:**
LCU 01 Vegetated hills	**Moderate** *Refer to Appendix B1*	• Due to the existing topographical changes and dense vegetation, the number of publicly accessible locations to view the Project from within the LCU is likely to be limited. • Landscape elements such as the terrain and native vegetation which define and contribute to the scenic quality of the LCU will remain unchanged as a result of the proposal. This character is likely to remain unchanged to a large extent and minor alterations for few Leadville WTGs will not impact the scenic integrity of this LCU. • The vegetated hills are distinct from the general visual catchment from surrounding Landscape Character Units. The level to which it has the potential to alter the scenic integrity has been assessed based on the parameters of all surrounding LCUs.	• The valued features of this LCU include the densely vegetated ridgeline which provides a backdrop from the surrounding areas. The proposed development is likely to alter minor aspects of the existing visual character of the ridgeline and the heavily wooded character of the LCU will remain unchanged. • Due to the proximity of the Project Area to this LCU, there is the possibility of the turbines being a dominant feature within the landscape. However, the dense vegetation limits opportunities for these views from within the public domain. The close proximity reduces views to include a small portion of the Project Area. • Whilst the Project will be a noticeable element in the landscape, the key features of the LCU are likely to remain undisturbed.
LCU 02 Undulating farmlands	**Moderate** *Refer to Appendix B2*	• Although the proposed wind turbines are likely to alter small areas of the existing landscape as defined in this report for the Undulating farmlands LCU, the moderately dense vegetation and topographical changes typical of the LCU will largely remain unchanged. • The existing character of this LCU is defined by moderately gentle undulations that have been partially cleared to support agricultural activity. It is, therefore, a highly modified landscape which is a result of human intervention and land management. • The Project will be discernible from some public areas within the LCU, however it will not modify the visual catchment or scenic integrity of the Undulating farmlands LCU area due to existing roadside vegetation. • The Project will form a minor element in the overall visual landscape. The scenic quality of the LCU will be slightly altered as a result of the proposal.	• The key features of this LCU include cleared undulating valleys used for grazing and views to the foothills. These features are a result of continuous human intervention and the character is likely to remain largely unchanged. • Views to partially vegetated ranges (including the Project Area) form a visual backdrop when travelling along Black Stump Way to Coolah or along Golden Highway to Dunedoo. Although visible in the distance and in some areas the turbines will be a dominant feature, the Project is likely to occupy a small portion of the vegetated ridgelines and has the potential to have a low impact on visitors of the LCU. • The rolling hills are likely to remain a key feature of the landscape from areas surrounding this LCU. • Views to undulating farmlands (including the Project Area) characterise the arrival to Coolah from the northeast, and into Leadville from the west. Although visible in the distance, it is unlikely that the Project will dominate the existing visual character.
LCU 03 Alluvial plains	**Low** *Refer to Appendix B3*	• The proposed wind turbines are likely to be noticeable along the ridgelines from areas within the LCU due to the local topographical changes and proximity to the Project Area. The entire extent of the Project, however, will not be visible from any location. • The Alluvial plains LCU has a highly modified landscape character which makes the most of the rich fertile plains to support agriculture. The landscape is a result of human intervention over time. • The landscape elements which contribute to the scenic quality of the LCU will remain unchanged as a result of the proposal.	• The key features of this LCU include the vast, open landscapes spread across a flat terrain with scattered vegetation. Most vegetation corridors existing within the extents of this LCU formulate the moderately dense and intermittent riparian vegetation associates with rivers and creeks. Other areas within the LCU are cleared to accommodate grazing lands. • Although the proposed wind turbines are likely to slightly alter views toward the undulations from some limited locations, the landscape's riparian and agricultural character will remain the key feature of the landscape within this LCU.
LCU 04 Agricultural flats	**Low** *Refer to Appendix B4*	• The LCU is located in close proximity of LCU03 Alluvial Plains, and therefore, the landscape has similar scenic values. The terrain is largely flat with scattered vegetation in a cleared landscape. • The Project will be a noticeable element from some areas within the LCU, however they will not dominate the existing landscape character of the Agricultural flats LCU. • The Project will form a minor element in the overall visual landscape. The landscape elements which contribute to the scenic quality of the LCU will remain unchanged as a result of the proposal.	• This LCU is identified for its agricultural associations and generally flat landscape character. It also comprises of scattered low density dwellings on large rural lots. Residents engage in light agricultural activities such as grazing. • Views to rolling hills form a visual backdrop when travelling along Neilrex Road, Sir Ivan Ducherty Drive and Moorefield Road. The views towards the hills, however, are generally limited by roadside vegetation. • Whilst the Project will be a noticeable element in the landscape, the key features of the LCU are likely to remain undisturbed.
LCU 05 Towns and settlements	**Low** *Refer to Appendix B5*	• The Project Area is likely to be noticeable from some areas of the towns and settlements LCUs. However, for the most part the Project will not dominate the visual catchment of the LCU. • There are limited opportunities to view the Project Area within the LCU due to local screening factors and topographical undulations. • The current landscape character and scenic quality of the Nundle Rolling Foothills LCU is likely to be slightly altered in some locations due to the Project.	• Defined by moderately dense residences, the LCU spreads across the settlements of Coolah, Leadville and Uarbry. These settlements comprise of low density residences within the extents as well as scattered dwellings on the outskirts of these towns/villages. • It is important to note that whilst the proposed wind turbines will be a noticeable element on top of the ranges that these towns look toward, and in some areas a dominant feature, they will not disrupt central line of sight to the range because of their distance from these settlements.

Table 19. ***Summary of Visual Impacts on Landscape Character Units***

16.0 Mitigation Methods

16.1 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.

Mitigation methods considered for associated infrastructure has been included in ***Section 14.0***.

16.2 Project Layout and 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. It is important to note that as a result of community consultation during the development period, the Project has undergone many changes. The resulting layout has a substantially smaller development footprint to those previously considered and increases distances between turbines along the ridgeline. General guidelines for the design development of the Project have been outlined in the following section.

16.2.1 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.

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 as a result of community consultation during the development period, the Project has undergone many changes. The resulting layout has a substantially smaller development footprint to those previously considered. The above design principles have been considered in the siting of the proposed turbines to provide a balanced appearance along the ridgeline.

16.2.2 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.

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.

16.0 Mitigation Methods

16.3 Mitigation Methods for Residences

In accordance with the Bulletin, a detailed assessment of dwellings identified within the visual catchment has been undertaken and (where possible) mitigation methods have been recommended to assist in reducing any residual impacts. Generally, mitigation measures are proposed for all non-participating dwellings with potential for a moderate or high visual impact rating.

Appendix E provides an overview of the potential mitigation options for each of the residences based on an assessment of potential visual impacts and consideration of the existing landscape character.

Screen planting was identified as a potential mitigation measure from dwellings with no intervening elements to reduce or fragment views to the Project. Supplementary planting has been suggested where views to the Project are fragmented by existing vegetation from non-participating dwellings. The principles of both methods have been outlined in the following sections.

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 could 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.

Due to the windy nature of the Site, a number of surrounding dwellings have existing wind break planting which will screen the Project. Where turbines are located close to the dwelling or existing intervening vegetation is thin, supplementary planting is a mitigation method that has been identified. Supplementary planting in keeping with the existing landscape character would further reduce potential visibility and ensure longevity of the intervening vegetation.

An example of how supplementary planting could be used to mitigate potential views towards visible WTGs from **Dwelling 76** is illustrated in ***Figure 36***. 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.

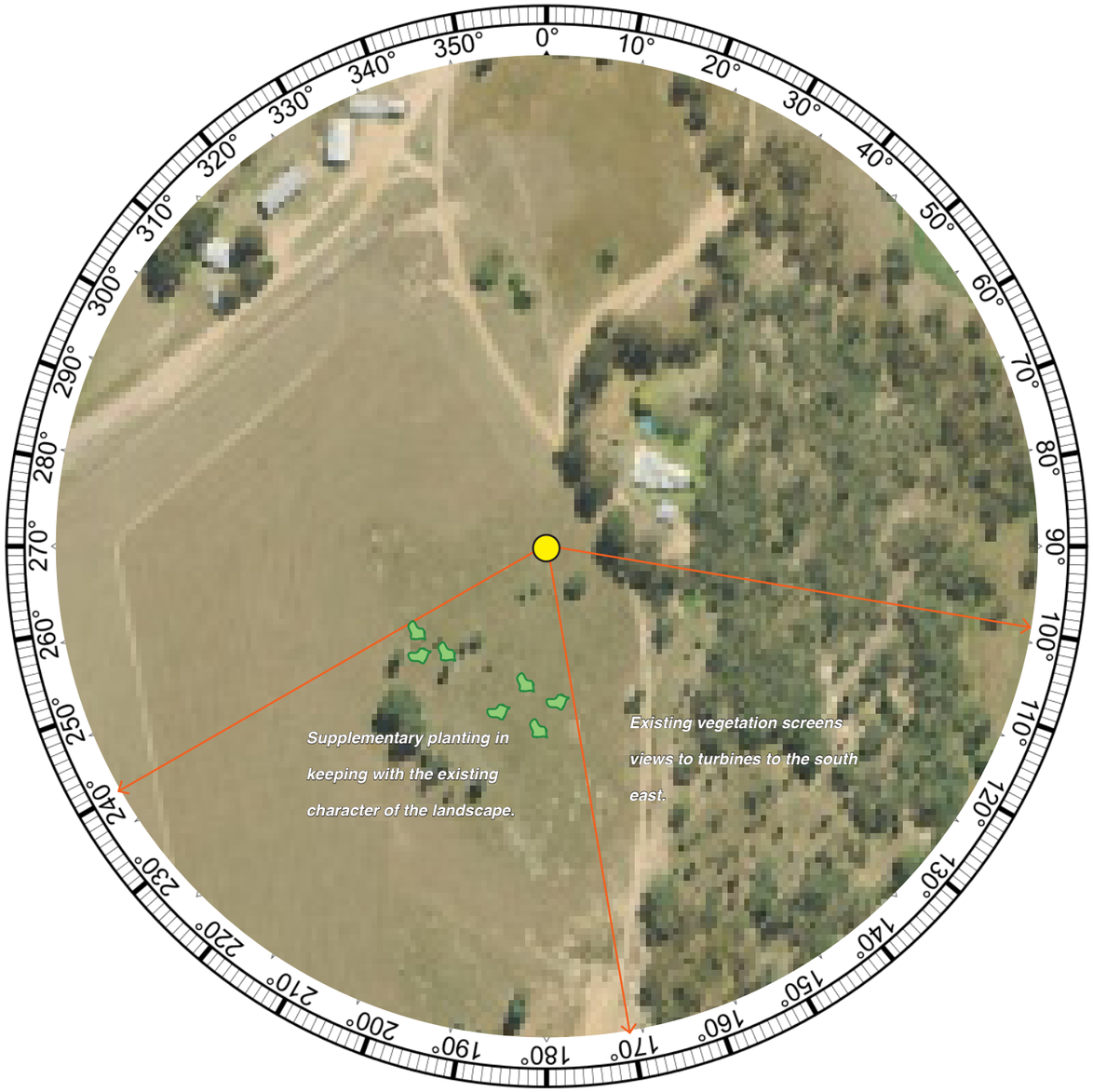


***Figure 35:* Example of screen / supplementary planting set back from dwelling**
(Image Source: Google Maps 2020)

16.0 Mitigation Methods

Extent of turbines (Based on topography alone)

Note: Existing vegetation to the south west screens views to turbines

Note: Existing vegetation on the rise in the foreground fragments views to the turbines.

Proposed supplementary planting on the rise to the south in the foreground will assist in reducing the visibility of turbines.

***Figure 36:* Example of supplementary planting set back from residence (Dwelling 76)**

16.0 Mitigation Methods

16.4 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.

17.0 Evaluation of Visual Performance Objectives

17.1 Overview 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 provide a brief summary of the evaluation of 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 (4,950 m for VoW)	*Manage impacts as far as practicable, justify residual impacts, and describe proposed mitigation measures below the black line (3,350 for VoW). Consider screening between the blue line and the black line.*	*Consider screening below the black line (within 3,350m).*
Summary of LVIA Evaluation		
• *Refer to Section 6.0 - Visual Magnitude* **Dwellings within 3,350 m (below the black line):** • *42 non-participating landowner dwellings were identified within 3,350 metres of a proposed WTG* • *Further Detailed Assessment found the Project is likely to be screened by vegetation or topography from 20 non-participating dwellings within 3,350m.* • *Mitigation methods proposed for the remaining dwellings is likely to reduce impacts to an acceptable level.* **Dwellings within 3,350 m - 4,950 m (between the blue and black line):** • *70 non-participating dwellings were identified between 3,350 - 4,950 metres of the nearest proposed WTG (this includes 25 dwellings associated with Leadville).* • *Two (2) of these dwellings have no visibility of the Project due to topography.* • *Vegetation is likely to screen the proposed from a further 20 dwellings.* • *Mitigation methods proposed for the remaining dwellings is likely to reduce impacts to an acceptable level.*		

Table 12. Visual Magnitude - Evaluation of Visual Performance Objectives

17.0 Evaluation of 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

Assessment Notes:

- The Visual Influence Zone (VIZ) was identified for 30 viewpoints within the Study Area, where relevant for viewpoints rated as VIZ1 and VIZ2 the objectives were evaluated.
  Refer to Section 8.0 and Appendix C: Viewpoint Analysis

- The potential for the project to affect the Scenic Integrity of the existing landscape character was summarized for each Landscape Character Unit.
  Refer to Section 15 and Appendix F: Overview of LCUs

- The LVIA concluded that whilst the Project is likely to be a visible element in the landscape, the scenic integrity of the existing landscape character is likely to remain intact.

Table 13. Landscape Scenic Integrity - Evaluation of Visual Performance Objectives

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 will remain the dominant features of the landscape. The Project is unlikely to result in major disruptions to the key landscape features.
  Refer to Section 15 and Appendix F: Overview of LCUs

Table 14. Key Feature Disruption - Evaluation of Visual Performance Objectives

17.0 Evaluation of Visual Performance Objectives

Multiple Wind Turbine Effects

Objectives (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 60° sectors.*
- *Level 2: (Moderate Sensitivity) - Wind Turbines visible within the effective horizontal views in three or more 60° sectors.*

Summary of LVIA Evaluation

Assessment Notes:

- All viewers identified using the Multiple Effect Tool (based on 2D plan assessment) are Level 2 Sensitivity (Rural Dwelling). The Bulletin recommends further assessment to Rural Dwellings (Level 2 Sensitivity) identified as having the potential to view more than two (2) 60° sectors when using the Multiple Effect Tool.
  Refer to Section 6.0: Preliminary Assessment Tools

Summary of Assessment:

Based on a 2D Assessment:

- 14 non-participating dwellings have turbines associated with VoW Project alone located within up to ***three (3) 60 degree sectors***.
- Eight (8) non-participating dwellings have turbines located within up to four (4) 60 degree sectors.
  These non-participating dwellings have been assessed in detail in Appendix E.

- Eight (8) non-participating dwellings have up to three (3) 60 degree sectors of turbines associated with the VoW Project and LRWF Project. Detailed assessment of these have been included in ***Section 13.0***. It is determined that intervening factors such as vegetation and built form reduce the potential visibility of turbines in some of the 60 degree sectors.

Table 15. Multiple Wind Turbine Effects - Evaluation of Visual Performance Objectives

Shadow Flicker and Blade Glint - Visual Performance Objectives

Objectives (Applies to all Visual Influence Zones)

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

Summary of LVIA Evaluation

Shadow Flicker:

- No methodology is provided for the assessment of shadow flicker. Moir LA have utilised the Draft National Guidelines to assist in formulating a methodology for assessment.
- A total of 15 non-participating dwellings were identified with potential shadow flicker hours.
- Of the 15 non-participating dwellings with potential shadow flicker, no non-participating dwellings will experience 30 of shadow flicker per year.
- The assessment is based on a worst case scenario considering topography alone. Vegetation is likely to reduce the actual shadow flicker potential at both dwellings.

Refer to Section 11.1 Shadow Flicker

Blade Glint:

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

Refer to Section 11.5 Blade Glint

Table 16. Shadow Flicker and Blade Glint - Evaluation of Visual Performance Objectives

17.0 Evaluation of Visual Performance Objectives

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 effect from night lighting has the potential to have a visual impact on receptors including motorists and residents in the area. • Mitigation methods have been outlined in Section 11.0. *Refer to Section 11.0 Night Lighting Assessment*

Table 17. Aviation Hazard Lighting - Evaluation of Visual Performance Objectives

18.0 Conclusion

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.

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.

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 area 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.

The visual impact of the wind turbines are lessened as the distance of the vantage point from the Project 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.

The greatest visual effect is most likely to be felt by residents in the immediate vicinity of the wind farm. Mitigation methods incorporated into the design process in conjunction with landscape and visual screening will have a positive effect on reducing any visual impact of proposed wind farm. Through mitigation methods described it will be possible to significantly reduce the visual impact to an acceptable level at sensitive viewpoints such as rural residential properties.

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 with the appropriate mitigation measures implemented, the proposed Valley of the Winds Wind Farm can be developed accordance with the visual performance objectives of the Bulletin.

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