Appendix F

Delburn Wind Farm

Landscape and Visual Impact Assessment

2 | FINAL

10 December 2020

Delburn Wind Farm Pty Ltd (An OSMI Australia company)

Delburn Wind Farm

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1. Introduction

Delburn Wind Farm Pty Ltd (an OSMI Australia Company) is seeking approval to develop a new wind energy facility in southeast Victoria.

The proposed Delburn Wind Farm (the Project) will include:

- Up to 33 wind turbines, with an overall height of 250 m;
- Internal access tracks;
- Wind monitoring masts;
- Operations and maintenance facilities; and
- Underground cabling and necessary infrastructure to connect the Project to the grid.

The Project, inclusive of the grid connecting infrastructure, is proposed within the existing HVP Plantations Thorpdale Tree Farm.

The original turbine layout proposed up to 53 wind turbines with an overall height of 250 m, internal access tracks, wind monitoring stations, underground cabling and an on-site terminal station. This layout has been refined to remove 20 turbines in response to a range of initial concerns which include views and visual amenity.

1.1 Purpose of this report

The purpose of this report is to assess the landscape and visual impacts that may be brought about by the Project. This report is to be submitted as part of the Permit Application.

2. Methodology

The methodology used within this LVIA of the proposed Delburn Wind Farm includes the following steps and tasks.

2.1 Project Description

This chapter outlines the visual components of the Delburn Wind Farm that have the potential to contribute to views and visual impact. These components will include the proposed wind turbines, access roads, permanent buildings and construction activity. The major visual component of this Project, however, will be the wind turbines and will be the main focus of this LVIA.

2.2 Viewshed

Defining the viewshed of the Project is based upon the key elevation or overall change in height that might be brought about by the key components of the Project. The viewshed is considered as the distance at which the visual changes brought about by the Project may no longer contribute to views in a meaningful way based on parameters of the human vision. The rationale behind the definition of the viewshed is discussed in Section 4 of this report.

This viewshed extent will be used to define the study area for this LVIA report.

2.2.1 Zones of Visual Influence

Zones of Visual Influence (ZVI) quantify the scale of the potential effects of a Project over varying distances. This step is a useful measure to contemplate the potential for visual dominance of the project in views.

2.3 Planning Policy Framework

This chapter will identify the relevant policies and provisions that apply to areas within the viewshed of the Project that are relevant to views, landscape sensitivity and visual impact.

This will assist in understanding the sensitivities of different landscapes within the viewshed.

2.4 Landscape Character

This chapter will review the landscape character of the viewshed to identify landscape units.

2.4.1 Landscape Units and Sensitivity

Landscape Units are based on the physical characteristics, land-use and planning provisions of the area within the Viewshed. Features that assist in defining the landscape units and a sensitivity rating include geology, vegetation, topography and drainage patterns, urban development and modification of the landscape. The use of the land and the underlying protections of an area that are afforded by the provisions within the planning scheme assist to determine the sensitivity of that area to visual change. This step recognises that the planning scheme identifies landscapes that are significant, rare or threatened and provides guidance on how these features may be preserved.

The sensitivity of a landscape unit considers the ability for a landscape to accommodate the level of change that is proposed by a project. Generally, the greater the extent of modifications in an area, or the prevalence of the landscape type and its use, the lower the sensitivity that landscape will be to visual change.

These landscape units will assist in understanding a particular landscape's sensitivity to visual change.

2.5 Seen Area Analysis

A Seen Area Analysis (SAA) utilizes Geographical Information Software (GIS) to map the areas of theoretical visibility of the Project, as a whole or in part, utilising topographical data alone. The SAA is a conservative

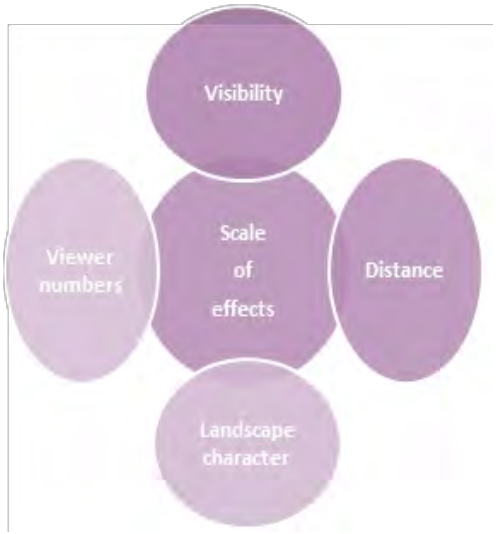
analysis tool as it does not take into account other factors that may affect visibility, such as intervening vegetation, built form or atmospheric conditions such as fog, low cloud or haze.

The SAA assists in selecting viewpoints which have theoretical visibility of the proposed turbines, to be assessed within the report.

2.6 Publicly Accessible Viewpoints

This chapter will assess the visual impact of the Project from indicative viewpoints within the public domain. This assessment will be supported by photomontage imagery to assist with describing the location, scale and visibility of the Project.

The visual impact of a wind farm development from the public domain is based upon four criteria which are supported by the preceding steps and assessment tasks. These criteria and their influence in determining the assessment of the overall visual impact from the public domain are set out below:



- **Visibility**: The visibility of the Project elements can be affected by topography, vegetation, built form and infrastructure.
- **Distance:** Turbine visibility and dominance will decrease with distance. The Zones of Visual Influence (ZVI) provides an indication of visual dominance and potential impact based on distance. This criterion is one of several to be considered when assessing the overall visual impact of the Project from any location.
- **Landscape Character and Sensitivity:** Landscape character of areas is based upon visual features such as topography, vegetation and the use of the land, the naturalness of the area and planning provisions. Sensitivity may also be influenced by specific landscape studies and assessments within the project viewshed. Typically, a modified landscape that is prevalent within the viewshed or the region is less sensitive than one that is ostensibly natural or protected for its environmental, ecological or cultural values.
- **Viewer numbers:** The overall level of visual impact, which considers these four criteria, will decrease where there are fewer people able to view the Project. Conversely, the level of visual impact may also increase where the viewing location is a recognised vantage point or tourist route where viewer numbers from these locations would be rated as 'high'.

A summary table is provided at the end of each of the viewpoint assessments to outline the key quantitative elements that form part of the views and visual impacts. The overall visual impact considers both qualitative quantitative criteria which is discussed at each viewpoint. The sum of the quantitative considerations alone does not form the basis of the overall visual impact.

The overall visual effect will range from Nil to High. The definition for each scale is discussed below.

2.6.1 Scale of Effects

The overall visual impact of the Project from an indicative publicly accessible viewpoint has been assessed using the following scale:

Nil Visual Impact

Nil – There are no visible turbines and the Project will be screened by topography, vegetation or buildings and structures. Where no turbines are visible there will be no visual impact.

Negligible Visual Impact

Negligible – minute level of effect that is barely discernible over ordinary day-to-day effects. The assessment of a 'negligible' level of visual impact is usually based on distance. That is, the wind farm is at such a distance that, when visible in good weather, it would be a minute element in the view within a modified landscape. If there is limited visibility of turbines such as tip of blades only due to intervening topography, vegetation or buildings and structures the visual impact would also be considered negligible.

Low Visual Impact

Low – visual impacts are those where the Project is noticeable but that will not cause significant adverse impacts. The assessment of a "low" level of visual impact will be arrived at if the rating of several of the four criteria, (visibility, distance, viewer numbers and landscape sensitivity), are assessed as low.

Medium/Moderate Visual Impact

Medium/Moderate – visual impact may occur when several of the four assessment criteria are considered as higher than "low" or the visual effects can be mitigated/remedied from an initial rating of High. This will be moderated by the context of the existing view and the modifications within the landscape

High Visual Impact

High or unacceptable adverse effect – extensive adverse effects that cannot be avoided, remedied or mitigated. The assessment of a "high or unacceptable adverse effect" from a publicly accessible viewpoint requires the assessment of all criteria to be high. For example, a highly sensitive landscape, viewed by many people, near the proposed wind farm where turbines are visible would lead to an assessment of an unacceptable adverse effect.

Positive Visual Impact

Positive Visual Impact – is a visual change that improves the outlook or view. For renewable energy projects, a positive visual impact may be experienced where the individual viewer appreciates the view of wind turbines in the landscape or the link to renewable energy. This positive reaction is supported by the findings in numerous community perceptions surveys undertaken within Australia and globally.

2.7 Residential Viewpoints

An assessment of individual residential dwellings within 6.0km of the nearest turbine will be undertaken by this Landscape and Visual Impact Assessment.

The assessment of visual impact from residences is different from that undertaken from publicly accessible viewpoints in that visitor numbers is not applicable and landscape sensitivity is also always rated as 'high'. It is recognised that people feel most strongly about the view from their house and areas of attached outdoor living spaces.

Many of the residential site visits have been assisted by the application of proprietary augmented reality software undertaken by the client.

2.8 Photomontages and Project Imagery

Project imagery relied upon within this report includes traditional photomontages, prepared by Jacobs, virtual reality imagery prepared by Ignition Immersive Studios and Augmented Reality (AR) imagery developed through TrueView ®. True View is proprietary software developed specifically for wind farm projects in the United Kingdom. Combined, this imagery assists to demonstrate the 250 m high wind turbines in a range of landscape settings, viewing angles and distances and the effectiveness of vegetation and landscape screening in screening or filtering views towards the Project.

Virtual reality and TrueView ® imagery have been tested for technical and perceptual accuracy. Virtual reality imagery was compared by capturing high resolution still images from virtual reality scenes which were overlaid over Jacobs photomontages to discern key reference points such as turbine placement, tower scale and the

prominence of existing landscape features. This imagery is closely aligned both technically and perceptually to the methodology developed for traditional photomontages that were utilised in the Preliminary Landscape and Visual Impact Assessment and that has been applied and tested for many projects, including wind farms across Australia.

Testing of the TrueView ® imagery was undertaken using the same techniques for virtual reality and in the field. In field testing comprised modelling the features of the existing Bald Hills Wind Farm and existing features at the project site such as the meteorological mast and topography. This imagery proved to be technically accurate where the relative scale of turbines and existing features were aligned in TrueView. However, testing determined that distant features in both the Bald Hills Wind Farm trials and at the Project site appeared to be smaller or less visually apparent in the TrueView ® views than when observed on site. Similar to the reduced apparent scale of existing features in background elements, this would also result in the scale of turbines in the background of views being similarly understated. This is not dissimilar to comparing imagery taken using wide-angle which will understate objects in the background or zoom lenses which will overstate these same objects. For the reasons of perceptual accuracy, the AR imagery has been used to guide conversations regarding the technical placement and scale of the proposed turbines in views. The photomontages, which provide for a range of distances should be relied upon as set out in the methodology below to consider the perceptual scale of turbines.

The following section describes the methodology for the preparation of the still photomontages used within the Preliminary Landscape and Visual Impact Assessment and also included in this assessment. This sets out the technical accuracy aspects of the imagery and how to achieve perceptual accuracy. The methodology for preparing the Virtual Reality imagery which has formed the basis of the photomontages of the final project layout is described below.

2.8.1 Lens size and photos used within the photomontages

Photomontages are prepared to show the change in a fixed view of 60° horizontal and either 10° or 15° in the vertical field of view. The 60° horizontal field of view represents the central cone of view in which symbol recognition and colour discrimination can occur. By using a standard field of view (60° horizontal and 10° or 15° vertical) the photomontages can also assist to portray the scale of the proposed wind turbines when viewed over various distances. The 60° horizontal field of view is important to demonstrate the context and scale of the Project in views.

The vertical field of view assists to represent the central field of view of human vision as shown in Figure 2-1.

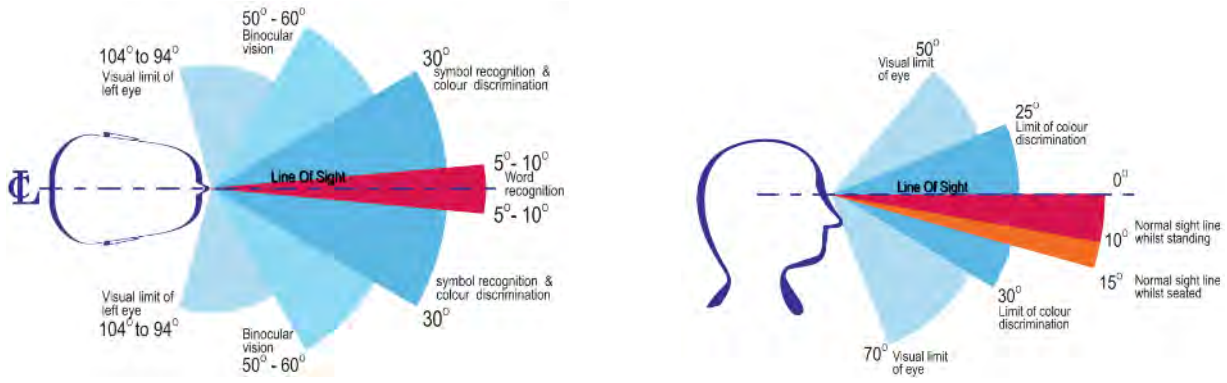


Figure 2-1: Horizontal and Vertical field of view (Human Dimension and Interior Space, Julius Panero & Martin Zellnik, Witney Library of Design,1979)

Similar data can be found in the more recent publication entitled 'The Measure of Man and Woman, Current Edition', Henry Dreyfuss Associates, John Whiley & Sons, 2012.

The A3 photomontages, which are appended to this report in Appendix B, provide a better size in which to view the images in the context of the report and the assessment.

For verification purposes, each photomontage included in the appendices includes:

- The existing view and proposed photomontage
- a 60° horizontal field of view of the existing view and photomontage: and
- a wireframe view of the computer model accompanied by a numbered turbine layout.

The latter technically illustrates how the photomontages are prepared. In these views vertical 'poles' or cylinders located features such as trees, towers or buildings and a 'mesh' models the existing topography into the view. These features allow the computer model (prepared in 3D Studio Max) and the photograph to be accurately aligned before preparing the final renderings.

This ensures that the proposed wind farm is accurately located within the photograph and then the rest of the model is removed, and the wind farm is rendered into the image. This is explained further in Section 2.8.3 below.

2.8.2 Computer Modelling and the wireframe model

Contour data as well as the proposed development are modelled within a computer program (3d Studio Max). A virtual camera is set up in the model at the GPS coordinates for each of the photographs that are being used within the panorama.

The digital model or wireframe view is then overlaid on the photographic panorama. Known points within survey information such as topography, building locations or other infrastructure are registered into the base photographs (or other predetermined points). For technical accuracy, these points must align. This verifies the location and apparent height and scale of the proposed development.

After the background reference points have been aligned, the wireframe is removed, leaving only the proposed wind farm facilities, which are rendered, either to match the lighting conditions at the time the photographs were taken or, more typically, to maximise their visibility by increasing their contrast against the background sky.

Photomontages are prepared with a 60° field of view, which follows the parameters of human vision. Wider panoramas are also used to indicate the full extent of the proposed wind farm facilities where appropriate.

2.8.3 GPS Coordinates and distance to the wind farm

The Nikon D850 camera also records the GPS coordinates as part of the metadata. GPS coordinates are also taken based on a separate hand-held GPS and the locations from which the photographs were taken is also marked on a digital map at the location of each photograph.

2.8.4 Imagery Locations

Photomontages have been prepared from nine locations to assist with informing the project design using an earlier iteration of the wind turbine layout v2.1, being 35 wind turbines. These photomontages were used to inform the environmental referrals and the Preliminary LVIA. For those viewpoints where photomontages were prepared the visual changes between the depicted layout and that being sought for approval do not result in a visual change and would not alter the assessments of the turbines in either a visual or a landscape context. Therefore, these photomontages are still relevant for informing this LVIA. The photomontages assist to show the range of viewing locations, viewing angles and distances towards the project. The photomontages have been included in the assessment of views at viewpoints H1, H5, L7, M6, L10, L14, L21, L22, M3 and T6.

The use of photomontages has been supplemented with Virtual Reality scenes from six locations surrounding the project, using a layout (v3.0) largely consistent with that being sought for approval (6 wind turbines have been subsequently micro sited less than 100m). The Virtual Reality imagery was presented at the community consultation days scheduled over March 13 and 14 whereby members of the surrounding and nearby communities were able to engage with the Project in a realistic setting that included the motion of the turbines, vehicles and 360° sound environment. Similar to the selection of locations from which to prepare photomontages, the Virtual Reality scenes were selected to better understand the range of views and landscape

settings in views towards the Project. The locations from each of the six scenes have been assessed at viewpoints H5, M15, L12, L16, L21 and T6.

Two wireframe views have also been prepared using the 'Concept Layout' (v1.5, being 53 wind turbines) only. These are shown at viewpoints L15 and T9. The reason for the wireframe views is that the proposed wind turbines would be largely screened by topography, vegetation or both. For this reason, the images have been included within the assessment as they demonstrate the potential visibility from clusters of residential dwellings or localities.

These photomontages are appended to this report (Refer Appendix B for A3 size photomontages with a 60° field of view).

It is recognised that the small photographs and the A3 photomontages included in this assessment are not indicative of the actual visual impact. The A3 images, which are appended to this report (Appendix B), are clearer than the smaller images in the text.

However, to view the photomontages in a way that they appear perceptually accurate, they need to be printed and viewed on A0 sized sheets and held at arms' length. When viewed at A0 the photomontages are representative of the level of visual alteration.

2.8.5 Virtual Reality

Virtual Reality imagery animates the turbines in the view, provides soundscapes from the location and captures the movement of vegetation, vehicles and elements typical of each location. These images provide useful and grounding context that cannot be captured or presented in still images and photomontages.

Virtual reality scenes were prepared from six locations around the project and in locations where turbines would be wholly visible or in part. The virtual reality scenes were made available at the community consultation and drop-in days undertaken in March 2020. The six locations were selected to provide for a range of viewing distances, view angles and landscape settings to assist the community to engage with the Project and understand how it would sit in the landscape should the Project be approved. The six selected locations included:

- Darlimurla Road
- McDonalds Track
- Morwell Thorpdale Road
- Strzelecki Highway
- Ten Mile Creek Road; and
- Yinnar Township.

A link to this imagery is provided on the Project's website. Where relevant, stills from the virtual reality scenes have been included at the corresponding viewpoint in the assessment of views and visual impact in Section 8 of this report.

2.8.6 Augmented Reality

The imagery prepared using the True View ® Visuals applies propriety software loaded within an iPad Pro. Imagery is captured on-site using the inbuilt camera with the iPad mounted and levelled on a tripod. Where possible, the existing view is aligned with an iPad based upon the embedded terrain model, existing features and project design. This initial imagery allows high-level views to be discussed in the field.

Following the capture of on-site imagery, the scenes are further refined to allow for fine-tuning and validation imagery including terrain matching through horizontal and vertical alignment, correction to the iPad's internal compass headings using fixed points in the landscape and subsequent rendering of the turbines into the image.

2.9 Landscape Mitigation

It is recognised that wind turbines are unavoidably visible and often contrast with the environments in which they are situated. The assessment and approvals process are required to consider the acceptability of impacts on landscape values, the amenity of communities and residential dwellings and the ability of mitigation to manage these impacts.

Mitigation options available to manage the visual impact from locations that are significantly visually affected by a wind farm include:

- vegetation screening to filter or screen the proposed wind turbines from dwellings or areas of private open space;
- re-siting of turbines to locations where they will have less visual impact (or removal if necessary).

This LVIA will consider the ability for landscape screening to be effective at filtering or screening views towards the Project.

3. Project Description

This section will describe and locate the Project relative to nearby towns and features and identify key elements of the Project relevant to preparing an LVIA.

3.1 Wind Farm Location

The Project site is located approximately 126 km east of Melbourne and 8.5 km south of Moe.

The Project will be located entirely within HVP's Thorpdale Tree Farm. Figure 3-1 shows the proposed site boundary in relation to nearby towns and major roads.

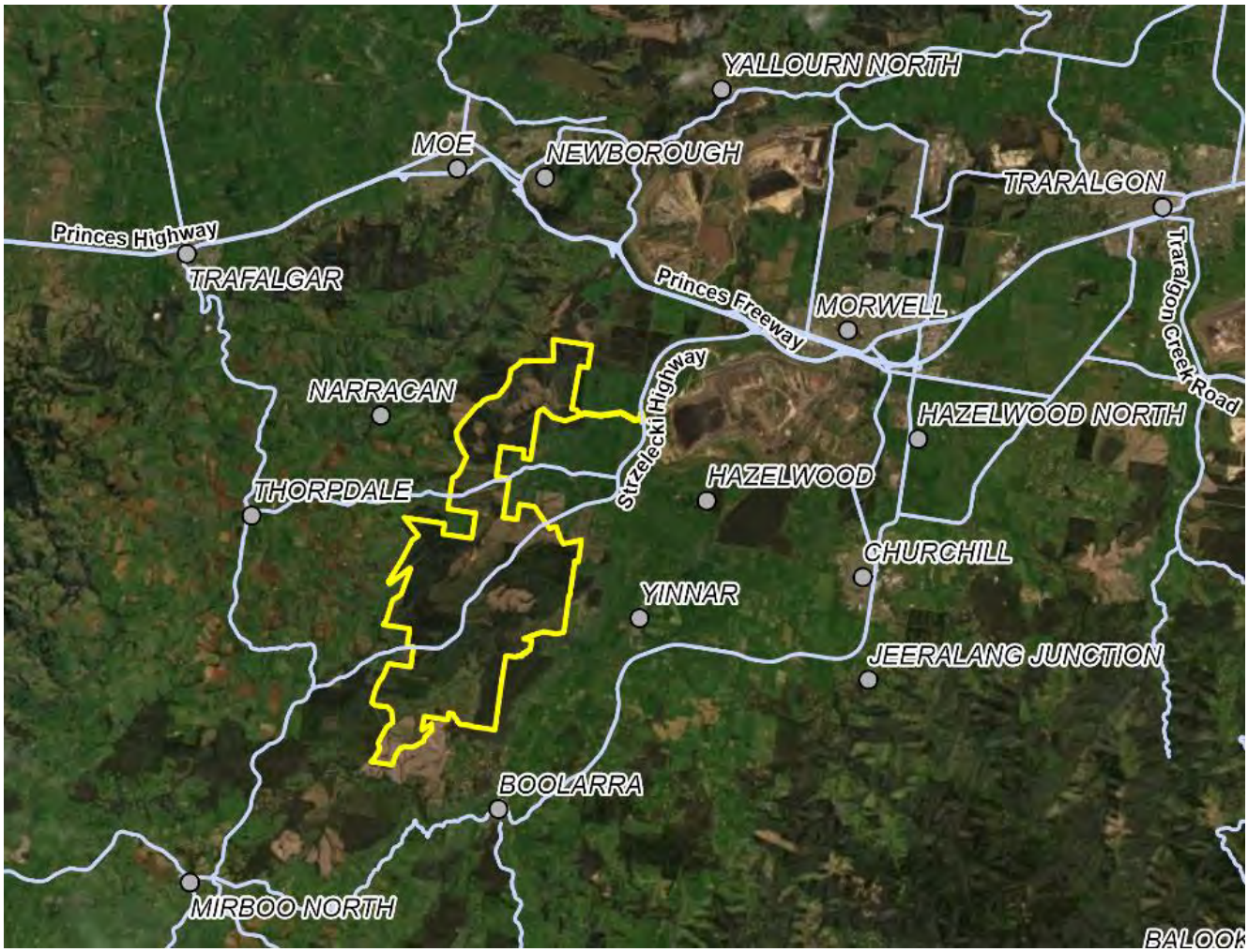


Figure 3-1: Site Location Map

Nearby towns and rural communities include Trafalgar, Narracan, and Coalville to the north-west, Thorpdale to the west, Delburn central to the Project, Hazelwood and Morwell to the northeast, Yinnar and Churchill to the east, Boolarra, and Mirboo North to the south of the Project.

Major roads include the Princes Freeway to the north of the Project and the Strzelecki Highway which passes through the existing pine plantations and the Project site. There are many sealed and gravel roads connecting farms, towns and rural communities.

The Grand Ridge Rail Trail is located to the south of the Project. The trail is approximately 13 km long and runs between Boolarra at its eastern end and Mirboo North to the west. The trail follows the line of the former Mirboo North railway line.

There are several open cut coal mines and operating coal-fired power stations located generally to the north, northeast and east of the Project area. Power stations are connected to the State electricity grid via a network of high voltage transmission lines which bisect the landscape. There are also several mining leases ranging from expiring, operational and exploratory to the northeast and east of the project.

A 500kV and a 220kV transmission line bisect the northern part of the Project site and near to the area of the proposed on-site substation.

3.2 Turbine Layout

The Project is seeking approval for a layout comprising 33 wind turbines. This layout has been revised from initial layouts which comprised up to 53 wind turbines at the inception of the Project. This report will focus on the application layout comprising 33 turbines which is referred to as Version 3.5.

Figure 3-2 shows the proposed layout of the application layout Version 3.5.

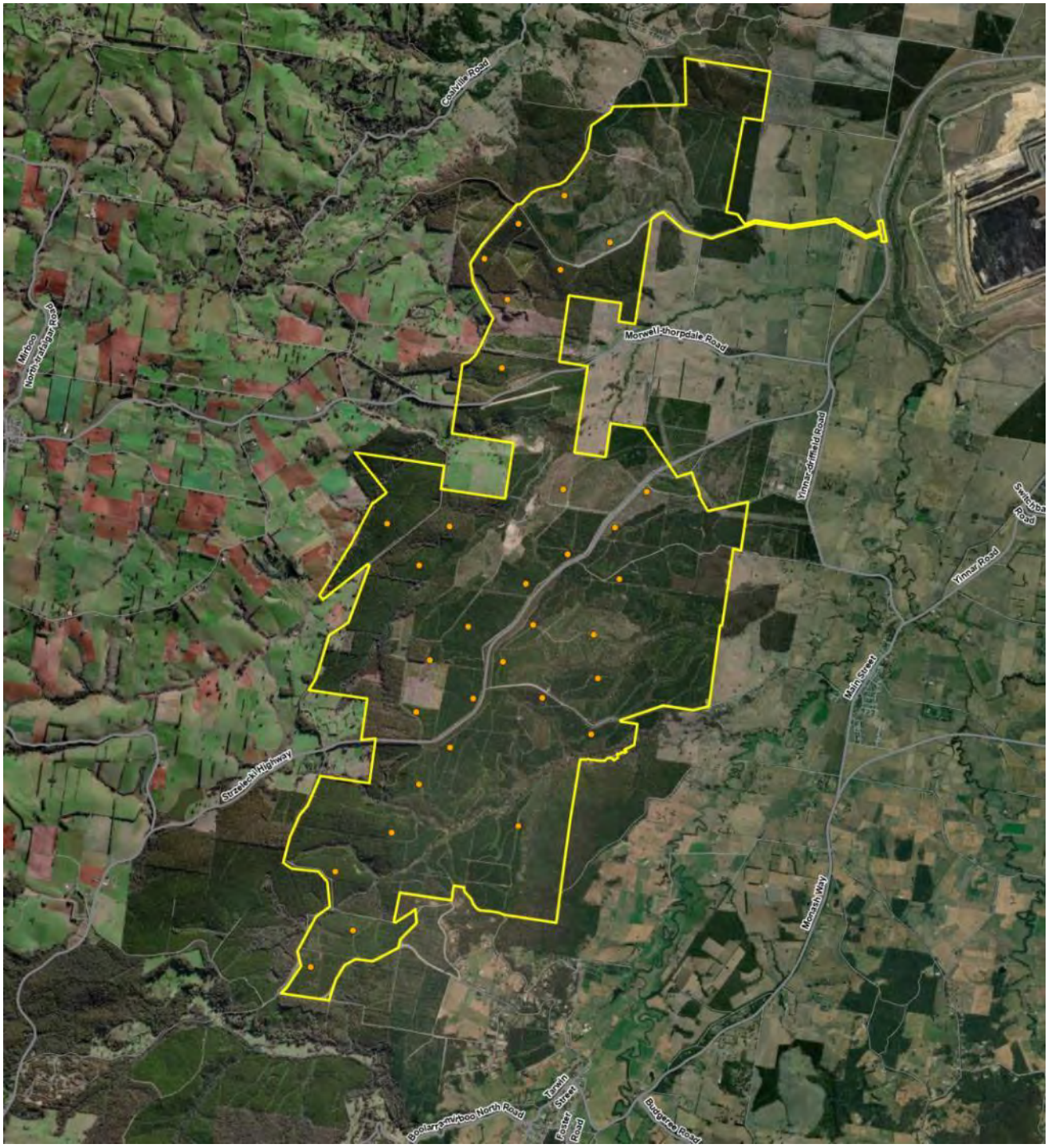


Figure 3-2: Application Layout (Version 3.5)

This turbine layout will form the basis of this LVIA report.

3.3 Wind Turbines

There are three key components of a wind turbine that are useful to assess the visual impact of a proposed wind farm. These are the overall turbine height, which forms the basis of the extent of the viewshed and the visual study area, rotor diameter, which supports the preparation of the Seen Area Analysis or GIS studies and the nacelle or hub height which is a static or constant element in views.

The final turbine specifications for the blade length and the nacelle height will be determined following approval of the Project and when a preferred turbine supplier has been selected. If approved, a fixed element will be the overall turbine height of 250 m. This overall height may comprise shorter blade lengths and a taller mast, or conversely longer turbine blades and a shorter mast.

Several recent Victorian Wind farms have sought to alter their approved blade length and mast height configurations. Visual studies comprising comparative photomontages prepared in support of the varying turbine configurations have determined that there is little perceptible difference between the turbine configurations. This assessment will adopt the following dimensions as the basis for the quantitative assessment tasks and mapping for establishing the Project viewshed or study area. The Zones of Visual Influence which assist to consider visual prominence over distance and the Seen Area Analysis which will identify patterns or locations of theoretical turbine visibility.

Turbine Feature	Specification for LVIA
Overall Height	250m above natural ground
Swept Path / Rotor Diameter	180m
Number of Turbines	33

It is recognised that the turbine height is not a fixed element and will vary depending on the blade position relative to its azimuth. To be conservative this assessment will be based on the overall height of 250 m above natural ground. This height will be used to determine the extent of viewshed, Zones of Visual Influence.

3.4 Aviation Obstacle Lighting

It is understood that aviation obstacle lighting is not required to be installed as recommended by the Aviation Impact Assessment.

This assessment has therefore not considered the potential for impacts from night lighting.

3.5 Grid Connection

Grid connecting infrastructure will require the construction transformers at the base of the turbines, underground 33 kV power lines and new substation and battery storage facility adjacent to an existing high voltage transmission line.

All new electrical infrastructure will be located within the existing timber plantations and the proposed site boundary.

3.5.1 Terminal Station

A new terminal station would be located at the northern end of the Project area adjacent to an existing 220 kV lattice tower transmission line. The substation and battery storage area are proposed to be located within a cleared area at the western end of Deans Road approximately 2.0 km west of the Strzelecki Highway. Figure 3-3 shows the location of the proposed on-site substation in blue and battery storage facility.

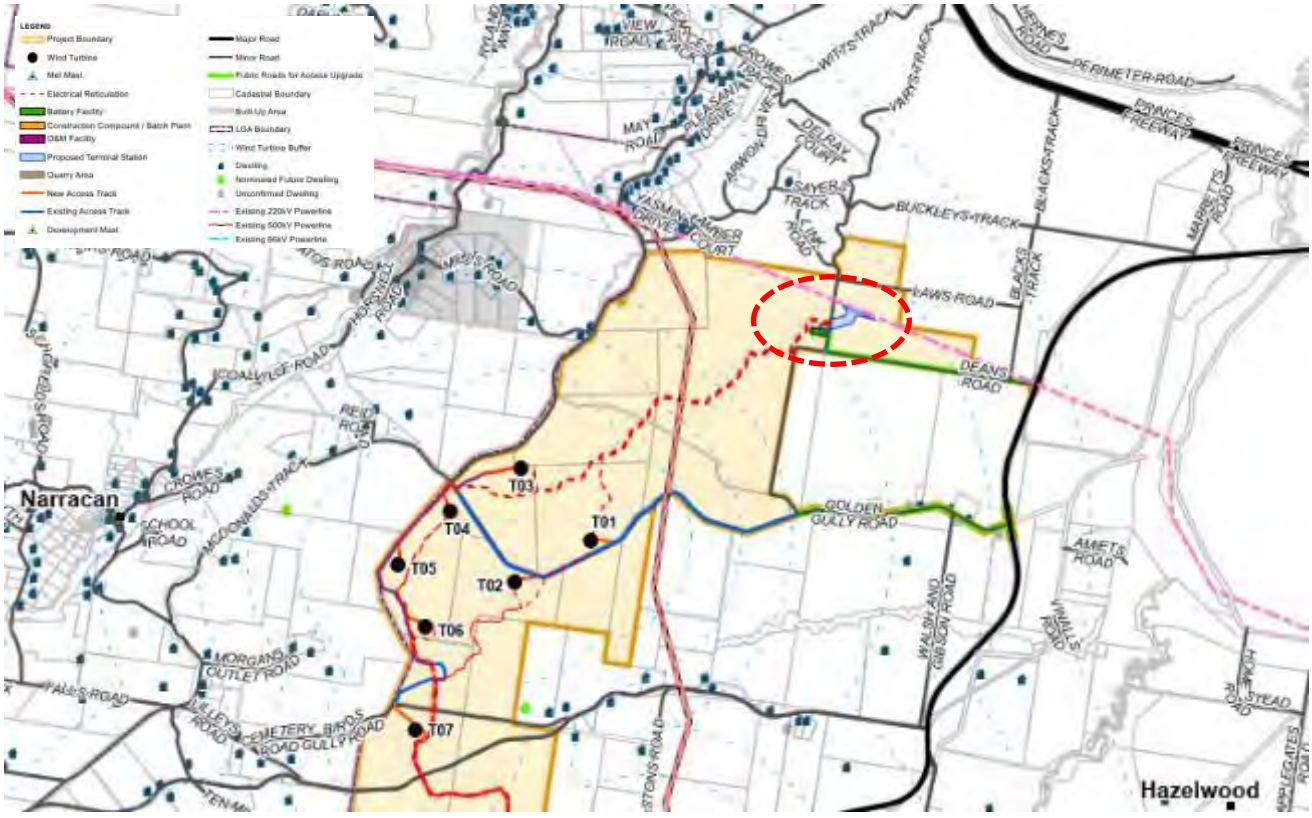


Figure 3-3: Substation and Battery Storage Investigation area (Source: OSMI)

Deans Road is a public road which is truncated near to the proposed terminal station and battery storage facility.

A separate approval is being sought for the terminal station and its' landscape and visual impacts will be assessed separately.

3.5.2 Battery Storage

The Project is investigating the viability and benefits that might be achieved through the inclusion of a battery storage facility as part of the Project. Should this be included, the battery storage area would be located near the terminal station.

The location of the proposed battery storage area will be considered in views assessed within this report.

Figure 3-4 shows an example of a typical battery storage facility for a wind farm project.

Figure 3-4: Typical battery storage

Although the above example is for a larger project, the dimensions of the individual power conversion units (PCU's) and battery storage facilities are similar in size and scale.

3.5.3 Powerlines

Electricity generated by the proposed wind turbines is required to be converted from Direct Current (DC) to alternating current (AC) via transformers located within each turbine.

The converted AC electricity will be transferred to the on-site terminal station via underground 33 kV power lines adjacent to internal access roads within the managed timber plantations.

3.6 Operations and Maintenance Facility

New operations and maintenance buildings will be required for use by permanent employees of the Project. These building will include offices and meeting spaces as well as storage of equipment, materials and vehicles and will be located on the corner of Smiths Rd and Strzelecki Highway within the managed timber plantation.

Visually, the operations and maintenance facilities will be similar to many other buildings and sheds found in the surrounding area.

3.7 Wind Monitoring Masts

Up to three wind monitoring stations are proposed across the Project site. Meteorological masts monitor wind characteristics across the life of the project. Typically, meteorological masts comprise steel lattice structures with tensioning wires for support and stability and are installed to the height of the nacelle. Newer technology includes mobile LIDAR units which are trailer mounted and can be moved across the site.

There are currently three wind monitoring stations installed as part of the early investigation of the Project. These include a 160 m high meteorological mast and two mobile LIDAR unit. Figure 3-5 shows the existing meteorological mast and mobile LIDAR unit in operation within the timber plantations.

Figure 3-5: Existing meteorological mast and LIDAR units

3.8 Access Tracks

The Project seeks to utilise existing operation and access tracks established within the managed plantation areas. This will limit impacts to the existing timber plantation operations, adjacent areas of native vegetation and minimise impacts on local traffic.

Some forestry tracks will be widened and upgraded to accommodate the articulation widths required to transport larger sections of turbine components and sections of new tracks between the existing forestry tracks and the final turbine locations.

There is limited visibility of the existing forestry tracks from locations beyond the site. This is due in part to existing vegetation and topography which screens views.

3.9 Construction

Construction activities include the excavation and pouring of the turbine foundations, transportation and assembly of the various turbine components, construction of the substation and grid connecting infrastructure, upgrading and construction of access tracks, modifications to intersections, and establishment of the operations and maintenance facilities.

The Project will also include the establishment of temporary on-site concrete batching plants for the construction of the foundations for the wind turbines which, amongst other things, assisting to reduce truck movements along local roads.

Figure 3-6 shows an example of a modular silo batching plant.

Figure 3-6: Portable batching plant

Following the completion of construction, all temporary works such as construction compounds and laydown areas would be removed and either rehabilitated or established as plantation areas. The batching plant area is proposed to be converted to a visitor area once construction is complete.

4. Viewshed

This section establishes a basis on which to determine the extent of the study area for visual impact, and the scale of the proposed 250 m high wind turbines when viewed at various distances.

The extent of the viewshed is the distance within which the proposed 250 m high wind turbines have the potential to be readily perceptible objects in views. This distance is established based upon the parameters of the human vision and the height of the proposed turbines. It may still be possible to see wind turbines from areas beyond the viewshed; however, they would be at a distance where they would not be conspicuous.

The parameters of human vision relevant to views and visual impact include the vertical and horizontal fields of view. These figures are based on data from '*Human Dimension and Interior Space*', *Julius Panero & Martin Zellnik, Witney Library of Design,1979*. These figures are supported by similar data in '*The Measure of Man and Woman, Revised Edition', Henry Dreyfuss Associates, John Whiley & Sons, 2012*. This data forms the basis for determining the viewshed for the Project.

Figure 4-1 shows the horizontal field of view.

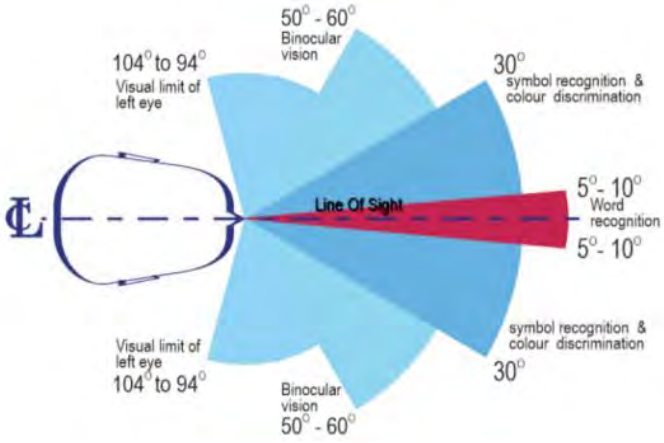


Figure 4-1 Horizontal field of view

The angle of the central field of vision is between 50º to 60º. This view angle is also relevant to the preparation and reproduction of perceptually accurate photomontages and printed reference imagery. By referencing a common benchmark, in this instance 60º, and utilising comparable camera specifications, scale of the proposed turbines over varying distances can be reliably considered.

Figure 4-2 shows similar parameters for the vertical field of view.

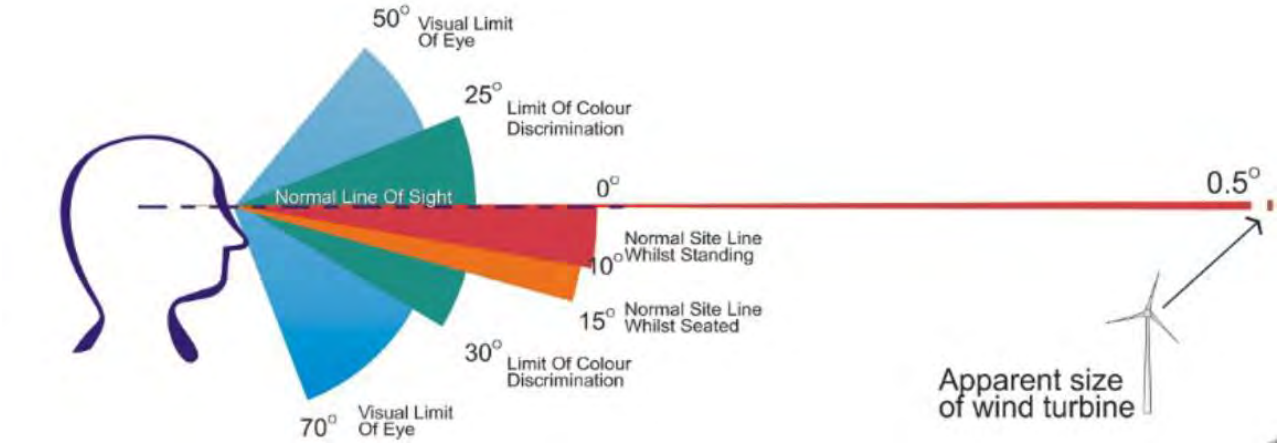


Figure 4-2: Vertical field of view

The "Normal" vertical field of view of a person is between 10° - 15°. The theoretical extent of the viewshed is considered to be a distance at which the tallest component of the Project would take up less than 5% or 0.5° of the "Normal" 10° of the vertical field of view.

With an overall height of 250 m, the proposed wind turbines are the largest element of the Project. The distance at which a 250 m high turbine would comprise 5% (0.5°) of the vertical field of view is 28.6 km.

Similar calculations for the horizontal field of view based on 50 ° - 60 ° central cone of view and the distance at which a swept path of 180 m will comprise 5% (0.5°) of the 50 ° horizontal field of view is 2.06 km. This calculation does not recognise the Project footprint, nor the vertical scale of the proposed wind turbines. The vertical field of view provides an alternative basis for calculating the extent of the viewshed.

The following section will describe the Zones of Visual Influence (ZVI) for the Turbines.

4.1 Zones of Visual Influence

Zones of Visual Influence (ZVI) assist to assess the visible scale of the proposed turbines over varying distances. The same principles used to determine the viewshed assist to define visual scale based on the distance to a turbine. For example, when a viewing location is closer to a turbine, the turbine would take up a greater percentage of the vertical field of view. This forms one element of several criteria that contribute to determining the overall visual impact of a project from viewing locations.

The ZVI, which will form part of the visual assessment of the Project is also calculated based upon the parameters of the human vision are set out in Table 4-1.

Table 4-1: Zones of Visual Influence

Distance to 250m high turbine	The vertical angle of view	Zones of Visual Influence
>28.60km	<0.5	**Visually insignificant – Extent of the project viewshed** The Project will be a very small element in views, is difficult to discern and will be invisible in some lighting or weather circumstances.
14.5-28.6km	0.5-1.0	**Discernible, but will not be dominant in views** The Project will be visible, however, will not be a dominant feature in views or the landscape.
6.0-14.5km	1.0-2.5	**Potentially noticeable and can dominate the landscape** Where visible, the Project has the potential to be noticeable in views.
3.0-6.0km	2.5-5.0	**Highly visible and will usually dominate the landscape** The Project has the potential to be a dominant visual element in views. The degree of visual intrusion will depend on the wind turbines' placement within the landscape and factors such as foreground screening.
<3.0km	>5.0	**Will always be visually dominant in the landscape** Dominates the landscape in which they are sited.

Figure 4-3 demonstrates the reducing scale of the Project relative to the Zones of Visual Influence are perceived in views across the landscape. That is, the further away a viewing location is from the Project, the smaller or lower the Project will appear in the vertical field of view.

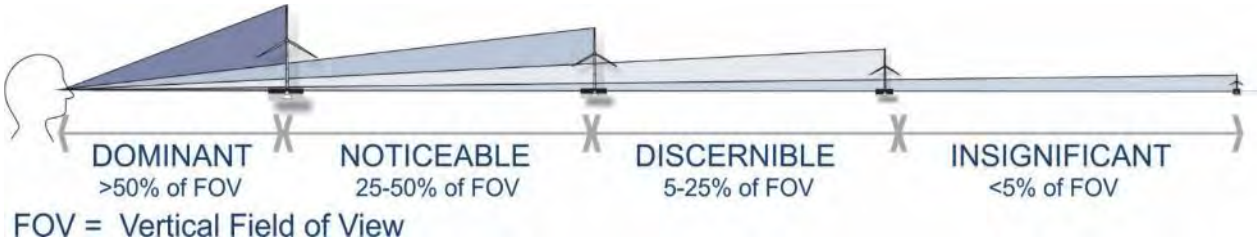


Figure 4-3: Zones of Visual Influence Diagram

The extent of the viewshed and the Zones of Visual Influence of the 33, 250 m high wind turbines proposed by the Delburn Wind Farm are shown in Figure 4-4.

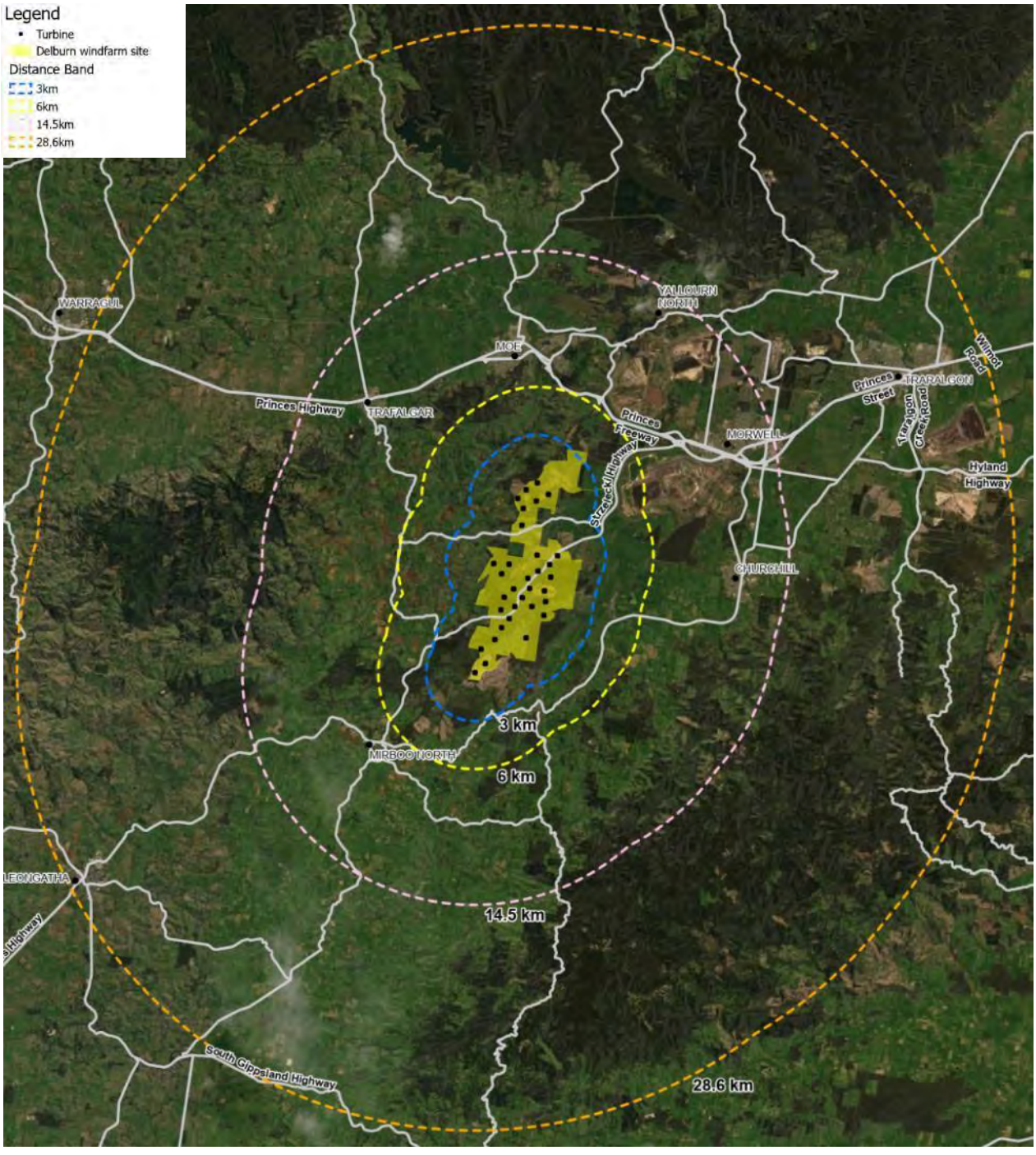


Figure 4-4: Zones of Visual Influence Map

ZVI's provide a guide to considering the visual scale of the proposed 250 m high wind turbines based on distance. The proposed wind turbines will be visually noticeable out to a distance of 28.6 km on clear days with good visibility. The proposed wind turbines have the potential to be highly visible and potentially dominant features in views from distances within 6.0 km. It is recognised that the apparent size of the Project will not change dramatically when a viewer moves from one distance band to another, for example from 5.9 km to 6.1 km.

With the viewshed established at 28.6 km, this following chapter will undertake a review of Planning Policies and Guidelines that are applicable to the assessment of landscape and visual impacts within the project viewshed.